



Academicth

INTERNATIONAL WORKSHOP
ADVANCES IN CLEANER PRODUCTION

“CLEANER PRODUCTION TOWARDS A SUSTAINABLE TRANSITION”

Sustainable Operations and Process Safety Management Systems: Implications for the Offshore Oil Industry and Petrobras

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Abstract

Recently, new processing dynamics of potentially dangerous products has increased flows, pressures, temperatures and other variables used in the process industries. With these new processing dynamics, the risk of major accidents around the world also increased. Due to the occurrence of major accidents, laws and regulations have been created to try to prevent this type of events, aiming to protect people, assets, the environment and corporate image. Management systems for process safety are used as a series of blocking barriers to prevent the development of major accidents. For the oil industry, there are some recommended practices from multiples institutes and government agencies. By employing a descriptive case study and documental analysis, the present study aims to compare the existing Process Safety Management Systems with the Health, Safety and Environment management system of a world leader energy company. More specifically, this research maps, compares and verifies which elements of these established management systems have been incorporated to the organization's HSE management system and provides a series of recommendations for practice and policy as well as contributions to the literature.

Keywords: *Process Safety Management; Major Accidents; Loss Prevention, Environment Protection.*

1. Introduction

The emergence of new technologies combined with new market requirements has generated major changes in the means of production in any industry. The opening of new consumer markets, globalization, stiffer competition, technological changes and the need to increase efficiency through cleaner production systems make the management of natural resource-based productive systems a challenging task (Dovi et al., 2009; Silvestre and Silva Neto, 2014a; 2014b). In the oil and gas industry it is not different (Silvestre and Dalcol, 2009; Matos and Silvestre, 2013) and these factors combined with the need to produce large volumes under more hostile conditions (i.e., higher pressure, temperature and flow rates, with reduced time for maintenance) generate a scenario where companies remain exposed to higher risks of accidents, which can cause irreparable environmental and/or social losses (Hall et al, 2012; Silvestre, 2014a; 2014b).

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São Paulo – Brazil – May 20th to 22nd - 2015

The history of the oil and gas supply is marked by several accidents with severe environmental and social impacts. For example, the Piper Alpha and Exxon Valdez accidents were milestones for the oil and gas industry (Vinnem, 2007; Zio, 2013). More recently, the 2010 Deepwater Horizon accident “revealed a series of management and technical gaps in the field of offshore drilling process. The loss of 11 lives and the short-term and long-term environmental impacts have brought the world a big lesson” (Mannan, 2012, p.10).

After these accidents, which usually become learning opportunities for the oil and gas industry, the society may observe the discussion and sometimes the implementation of new and stricter regulations, normative changes, new measures for risk reduction and additional protective barriers to prevent similar accidents (Gupta et al, 2005; Decola, 2009; ABS, 2010, NASA, 2013; Mendes et al., 2014). These new directives are usually proposed by a number of organizations and governmental agencies, but there are few mechanisms to ensure companies comply with all required guidelines to operate. This is because the globalization and the fact that supply chains are often spread across multiple countries, make the control and enforcement especially complex to be executed.

This study aims to help to address this gap and assess the main proposals of process safety management systems (PSMS) guidelines and compare them with each other and with the Petrobras’ Health, Safety and Environment (HSE) management system. More specifically, this research aims to verify if the Petrobras’ HSE management system meets all requirements of the main PSMS guidelines and contribute to the improvement of the Petrobras’ HSE management system by providing key recommendations for policy, practice and research.

The paper continues as follows: in the Section 2, we examine how accidents work as triggers for changes in safety regulations and procedures while in the Section 3, we discuss issues related to the Process Safety Management Systems. In the Section 4, we discuss the methods used in this research, followed by the case of Petrobras’ HSE management system in Section 5, and the results and discussion of this article in the Section 6

2. Recent discussion of accidents and regulation changes

The Seveso disaster, which occurred in a small chemical manufacturing in 1976 in Italy generated an important discussion across industries. Although, it occurred in the chemical industry, the Seveso accident gave rise to numerous standardized industrial safety regulations, affecting also the oil and gas industry. For example, in 1982, the first Seveso directive urged countries of the European Community to create legislation requiring companies with inventory of hazardous materials above a certain amount to prepare the safety report with a list of accidents that have occurred on the premises and measures to be taken to prevent these incidents to occur. In the United States the law called Right to Know Act, which requires that the facilities considered dangerous should declare publicly about the risks of its facilities and possible accidents that might occur was created, so the neighbors know about emergency scenarios and the actions that should be taken if these scenarios occur (Gupta et al, 2005).

Although regulations and safety investments for the oil and gas industry have been on the core of the industry discussions, historically severe accidents within the industry have also worked as triggers for change, especially related to offshore production facilities. For example, the accident with the oil tanker Exxon Valdez, which occurred on the coast of Alaska in 1989, was one of the most devastating environmental disasters worldwide, leading to death approximately 250,000 birds, 2,800 sea otters, 300 seals, 247 bald eagles, 22 killer whales and billions of salmon and herrings. This is due to the spill of approximately 37,000 ton of crude oil released in the Alaskan coast. (Zio, 2013). After the Exxon Valdez accident, the number of protective barriers to prevent similar accidents increased such as the Oil Pollution Act of 1990. This US law, among other directives, requires for double hull on tankers built since then and a timeline for phasing out of single hull vessels built before 1990, according to the capability of the ship and its age (Decola, 2009).

The Piper Alpha accident also generated changes in regulations. After the investigation of the accident, Lord Cullen elaborated the Cullen Report emphasizing the need for the Safety Case, which is a study required from the oil and gas companies whose content specifies the environmental and human risk associated with the production unit (NASA, 2013). More recently, the Deepwater Horizon accident has

prompted governments and industry to move forward and adopt new safety measures and procedures to reduce the risk to have accidents of such proportions.

3. Process Safety Management Systems

Process Safety Management Systems (PSMS) help ensure long-term sustainability of effective safety, health and environmental performance. The literature recognizes that effective PSMS drive sustainability performance (Mannan, 2012). The main idea is that if a hazard passes through an existing barrier (or multiple layers of barriers), then the incident/loss will occur. To prevent incidents and losses to occur, a PSMS needs to be broader and more comprehensive by implementing as many barriers or safeguards as possible to reduce the likelihood of the accidents to occur (REASON, 2007).

Process Safety Management Systems (PSMS) have usually two main drivers, which cover a full range of the incident spectrum: a) Occupational health and safety (OH&S) management, and b) engineering and process safety (EPS) management. The OH&S management at the workplace addresses the low severity-high frequency end of the incident spectrum. These essentially cover work related injuries (e.g. slips, trips, falls, injury sustained during manual handling, man-machine interfaces, exposure to high noise levels etc.). The main characteristics of the OH&S management system are injury prevention and rehabilitation. The EPS management involves the identification and management of hazards and risks involved in industrial facilities. And it consists of policies, in a process that involves establishment of procedures, standards and allocation of resources that will be strategic used to ensure safety. The implementation of a PSMS helps the company to manage the risk of the installation throughout its life cycle. (CCPS, 1993, CCPS, 1994, CCPS, 2008, Mannan, 2012).

Therefore, PSMS is a program or activity involving the application of management principles and analytical techniques to ensure the safety of industrial processes (CCPS, 1992, apud, Barbosa, 2009). The importance of effective PSMS has been stressed in a number of reports on safety in the oil and gas industry (Cullen, 1990; Mannan, 2012).

The likelihood of major accidents is generally very low. However, the absence of very unlikely events is not, in itself, a sufficient indication of good safety management (EPSC, 1996, apud Mannan, 2012). PSMS involves the application of management principles and analytical techniques to ensure the safety of industrial processes. According to Mannan, (2012) PSMS components are: 1. Safety Policy development and communication; 2. Organizational development; 3. Development and implementation of SMS; and 4. Development of a system to measure SMS performance through an auditing process.

In this context that the PSMS, which among other objectives seeks to prevent environmental damage without loss of containment of hazardous substances to the environment, in other words, through various tools, works to fluids remain within the vessels, piping and systems so incidents not occur, thus protecting the environment, human life and industrial facilities. These tools can be grouped into a Process Safety Management (PSM). (Mannan, 2012; Lima, 2013).

3.1. Seveso III

The first international experience for the prevention of major accidents occurred in June 1982, with the publication in the European Community (now European Union) of Directive 82/501/ECC, better known as "Seveso Directive" (PUIATTI, 2000). The Seveso accident contributed dramatically to the growth of public concern about the risks associated with the industrial production (De Marcho et al., 2000).

The Seveso directives have been updated through several versions. More recently, Seveso III (2003) proposes an inherent three-level provisioning of proportional controls, which in practice means that where the quantities are greater control is also greater. Companies working with hazardous substances in excess of the amounts set by the directive need to establish a Safety Report, a Safety Management System and Emergency Plan. The new Directive also includes detailed rules to ensure proper public consultation on individual projects and introduces stricter rules for inspections.

3.2. International Labour Organization (ILO) Convention 174

The International Labour Organization - ILO, in June 1993, issued the Convention 174, which aims at the prevention of major accidents involving dangerous substances and limit the consequences of such accidents (ILO, 2002). According to Rocha et al. (2006), after the Bhopal disaster in India in 1984, the ILO initiated a series of activities in the field of chemical safety, as the ILO Convention 170 on the safe use of chemicals in the workplace, approved in 1990, and its recommendations, which provide basis for a system of chemical safety. Special attention should be given to the ILO Convention 174 on the prevention of major industrial accidents, approved in 1993, accompanied by Recommendation 181 by a code of practice and a manual for the prevention of major industrial accidents. Its main objective is to prevent major accidents involving dangerous substances and limit their consequences (Machado, 2004)

According to the classification of Soares (2001), this international agreement composes the group of multilateral treaties and conventions on the environment, entitled "Protection of Workers, Regulating Toxic Materials, in several aspects, the Regulations of Certain Industrial Activities" and refers more specifically to the field of chemical safety. The Convention has its basis in the "Seveso Directive" and has the scope and application only in facilities exposed to major accidents, as the chemical, petrochemical, oil and gas, explosives, storage of dangerous products, terminals, etc.

3.3. SGSO – ANP

The National Petroleum Agency (ANP) is the regulator of the activities of the oil and gas industry and the biofuels industry in Brazil. After the accident of the P-36, ANP conducted a benchmarking study with the regulatory agencies in other countries, especially the United States, Norway and the UK to set its model of Operational Safety Management in 2007 (ANP, 2007).

Through Resolution Nº. 43/2007, ANP established the Operational Safety Management System (SGSO), whose scope is offshore exploration and production, i.e., drilling, completion, well intervention, production of oil and natural gas, primary oil processing, storage, oil transferring and compression and transferring of natural gas (ANP, 2007; Mendes et al, 2014). The SGSO aims to establish the requirements and guidelines for implementation and operation of PSMS based on the adoption of 17 Management Practices (MP) divided into three categories: a) leadership, staff and management (1: Safety Culture, Commitment and Managerial Responsibility; 2: Workforce commitment; 3: Qualification, Training and Personal Performance; 4: Working Environment and Human Factors; 5: Selection, Control and Management of Contractors; 6: Monitoring and Continuous Performance Improvement; 7: Auditing; 8: Information Management and Documentation; and 9: Incident Investigation), b) installation and technology (10: Design, Construction, Installation and Decommissioning; 11: Critical Elements of Operational Safety; 12: Risk Identification and Risk Analysis; 13: Mechanical integrity; and 14: Planning and Management of Major Emergencies), and c) operational practices (15: Operational Procedures; 16: Management of Change; and 17: Safe Work Practice and Control Procedures in Special Activities).

3.4. API RP 750

API Recommended Practice 750 was developed by the American Petroleum Institute, directed to the oil and gas industry (API, 1990). API model has 11 elements. Management commitment, responsibility and accountability, and employee participation/communication have not been included as separate elements. Its 11 elements are: Process safety information; Process hazard analysis; Management of change; Operating procedures; Safe work practices; Training; Assuring the quality and mechanical integrity of critical equipment; Pre-start-up safety review; Emergency response and control; Investigation of process-related incidents; Audit of process hazards management systems (API, 1990).

3.5. Center for Chemical Process Safety - CCPS

The CCPS was created by the American Institute of Chemical Engineers (AIChE) in 1985, after the accident at Bhopal, India, in order to contribute to the evolution of process safety in the chemical, pharmaceutical and oil industries. The CCPS brings together companies in the industry, government agencies, consultants and academics.

The PSMS proposed by the CCPS consists of 20 elements, structured around four blocks: Block 1 – Commitment to process safety (1.1 Process safety culture; 1.2 Standards, Codes, Regulations and Laws; 1.3 Process safety competency; 1.4 Workforce involvement; and 1.5 Stakeholders outreach); Block 2 – Understand Hazards and Evaluate Risk (2.1 Process Knowledge Management; and 2.2 Hazard Identification and Risk Analysis), Block 3 – Risk Management (3.1 Operating Procedures; 3.2 Safe Work Practices; 3.3 Asset Integrity and Reliability; 3.4 Contractor Management; 3.5 Training and Performance Assurance; 3.6 Management of Change; 3.7 Operational Readiness; 3.8 Conduct of Operations; 3.9 Emergency Management), and Block 4 – Learn from Experience (4.1 Incident Investigation; 4.2 Measurement and Metrics; 4.3 Auditing; and 4.4 Management Review and Continuous Improvement) (CCPS, 1993, CCPS, 1994, Frank, 2007, CCPS, 2008).

4. Material and Methods

Research consists of a formal procedure, with method of reflective thinking that takes a scientific approach, through which we can know the reality or discover partial truths, with the objective of finding answers to questions formulated by the researcher. The method used in the research should be related to the problem to be analyzed, depending on the observed phenomenon, objective and other issues involving the process of scientific research (Marconi and Lakatos, 2008).

According to Gil (2011), there are three research groups according to the proposed goals, classified as: exploratory, descriptive and explicative. In this study, was chose initially an exploratory research. The exploratory research are those whose primary purpose is to develop clarify and modify concepts and ideas, in order to formulate more precise hypotheses or searchable problems for further studies (Gil, 2011).

This research was done through a search in the Engineering Village database and and through a bibliographic and documentary review of bibliographic material published since 2009 and documents such (legislations, standards and guidelines). This exploratory research aims to present the evolution of the theme, through the main guidelines, regulations and management systems for process safety around the world and, subsequently, their influence and implementation (when applicable) in offshore production activities of oil and natural gas in Brazil.

Engineering Village (Elsevier) was chosen as search database because it has access to major journals that deal with the research's subject. Then, the work has a more descriptive characteristics. Descriptive studies are defined as those whose primary objective is description of the characteristics of a given population or phenomenon, or even the establishment of relationships between variables (Gil, 2011).

This study aims to present and compare the functions of the Management Systems of the main guidelines for the management of process safety around the world. It was chosen on this study, to analyze the following standards, national laws and international laws: Process Safety Management System of CCPS (Center for Chemical and Process Safety), ILO (International Labour Organization) Convention 174, Seveso Directive III these last two used mainly in North America and Europe, respectively. For the oil and gas industry there is recommended practices (RP) of API (American Petroleum Institute) 750 and the management practices of the Brazilian ANP's Operational Safety Management System.

This descriptive part of the research and the exploratory part of the research were done by search in Engineering Village databank and search of guidelines and legislations on the World Wide Web. This study also sought to evaluate how a large energy company in Brazil, object of case study, incorporated the functions of these guidelines for managing process safety in the company's health, safety and environment management system. Therefore, it also develops a case study that aimed to describe its management system based on the guidelines of process safety management.

According to Yin (2005), the case study is an empirical study that investigates a current phenomenon of real life, generally considering that the boundaries between the phenomenon and the context in which it operates are not clearly defined. It is actually a kind of history of the phenomenon, extracted

from multiple sources of evidence where any relevance to the chain of events that describe the phenomenon actually is particular potential for the case study.

The company, object of the case study, is the largest company in the energy sector in Brazil and was chosen for having enormous challenges for the management of process safety, due to its operations complexity in the sector. The case study, that intended to evaluate the process safety management system of the company based on main guidelines, was done from an extensive documentary research and review on the health, safety and environment management system company's guidelines.

5. The Case of Petrobras' Health, Safety and Environment Management System

According to Lima (2013), in 2001/2002, the company started the Safety Process Management Program helped by a consulting company. In that moment, despite of the program be called of a Process Safety Program, the main practices consolidated were regarded to occupational safety, i.e., practices to prevent accidents/incidents when a task is performed. The main idea of the 15 guidelines are placed above.

Guideline 1 – LEADERSHIP AND ACCOUNTABILITY: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. By integrating health, safety and environment into corporate strategy, the company confirms the commitment of all employees and contractors to excellence in these areas. The main focus on this guideline is "leadership by example" - The commitment with HSE performance of persons with positions such as president, director, manager, coordinator, supervisor, contract manager and contract inspector within the Company System is clear: the leadership shall be performed by example to seek the commitment of the workforce with HSE performance.

Guideline 2 – REGULATORY COMPLIANCE: The company's activities shall comply with current health, safety and environmental legislation. On this guideline, the company make a statement that the company's activities shall comply with current health, safety and environmental legislation, and all the employees and contractors must do the same.

Guideline 3 – RISK EVALUATION AND MANAGEMENT: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. The risks inherent to the company's activities shall be identified, evaluated and managed to prevent accidents and/or ensure the minimization of their effects.

Guideline 4 – NEW PROJECTS: To establish the general requirements to the HSE Management, aiming the excellence of HSE and Energetic Efficiency along of the project life cycle. The new project shall be in accordance with the legislation and incorporate the best, safety and environment practices during their entire life cycle.

Guideline 5 – OPERATION AND MAINTENANCE: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. The company's operations shall be carried out according to established procedures, and using adequate facilities and equipment, inspected and fit to meet health, safety and environment requirements.

Guideline 6 – MANAGEMENT OF CHANGE: To specify the necessary conditions to conform to Health, Safety and Environment Corporate Guideline. Temporary or permanent changes shall be evaluated in order to eliminate and/or minimize implementation risks.

Guideline 7 – ACQUISITION OF GOODS AND SERVICES: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. Contractors', suppliers' and partners' health, safety, and environmental performance shall be consistent with the company's system.

Guideline 8 – TRAINING, EDUCATION AND AWARENESS: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. Training, education and awareness shall be continuously promoted in order to reinforce the work force's commitment to health, safety and environmental performance.

Guideline 9 – INFORMATION MANAGEMENT: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. Information and knowledge regarding health, safety and environment shall be accurate, updated and documented in order to facilitate its consultation and use.

Guideline 10 – COMMUNICATION: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. Information concerning health, safety and environment shall be reported clearly, objectively and promptly to produce expected effects.

Guideline 11 – CONTINGENCY: To specify the requirements to conform to Health, Safety and Environment Corporate Guideline. Emergency situations should be quickly and effectively anticipated and confronted in order to reduce the effects of such situations.

Guideline 12 – COMMUNITY RELATIONS: To specify the necessary conditions to conform to Health, Safety and Environment Corporate Guideline. Care for the safety of the communities where it operates, by keeping the communities informed of impacts and/or risks eventually caused by its activities.

Guideline 13 – ACCIDENTS AND INCIDENTS ANALYSIS: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. Accidents and incidents caused by the company's activities shall be reviewed, investigated and documented to prevent their recurrence and/or to ensure the minimization of their effects.

Guideline 14 – PRODUCT STEWARDSHIP: To specify the necessary conditions to conform to Health, Safety and Environment (HSE) Corporate Guideline. The company shall take care of all health, safety and environmental aspects of its products from their origin to final destination, as well as be committed to continuously reduce potential impacts its products may cause.

Guideline 15 – ASSESSMENT AND CONTINUOUS IMPROVEMENT: To specify the necessary conditions to conform Health, Safety and Environment (HSE) Corporate Guideline – Assessment and Continuous Improvement. Assurance of health, safety and environmental performance shall be promoted at all levels of the company, in order to ensure improvements in these areas.

5. Results and Conclusions

All comparisons in this section were done arranging the Process Safety Systems according to the 4 blocks proposed by CCPS Management System (Commitment to Process Safety, Understand Hazards and Evaluate Risk, Manage Risk and Learn from Experience). After the assessment of the various proposals of systems to the management of process safety was possible to compare them to the Petrobras' HSE management system. The Table 1 shows a detailed comparison between the different systems.

A greater importance is given to those items presented in the Block "Understand and Evaluate Hazards Risk", which emphasizes Knowledge of the Process, Hazard Identification and Risk Analysis, because these items are essential to identify what can go wrong and what can be done to prevent major accidents.

The block "Manage Risk" implements the safeguards themselves. Both preventive (Procedures, Safe Work Practices, Asset Integrity and Reliability, Contractor Management, Training and Performance Assurance, Management of Change, Operational Readiness Conduct of Operations) and mitigatory (Emergency Management). Safe Work Practices is not a guideline on Petrobras' HSE management system due to the fact that it is an operational process covered by the Permit to Work procedure that is mandatory to every task involving risk. Management of Change and Safe Work Practice items are not in ILO 174 and Contractor Management item is not included in Seveso III or API RP 750. Training and performance assurance is not an issue present on the Seveso III safety system proposal.

The item Operational Readiness is not explicit in any system unless the on CCPS proposal. As a term used in the reliability of safety systems, when transported to an operator it is inherent to safe operating practices in any condition. However, Conduct of Operations is present only on Petrobras' HSE

management system due to the fact that as an operator all employees must follow which was determined by the employer and the employer has to ensure that.

Table 1: Safety Management Systems compared with CCPS Management System

MANAGEMENT FUNCTION	CCPS	ILO	API RP 750	ANP	PETROBRAS	SEVESO III
COMMITMENT TO PROCESS SAFETY	PROCESS SAFETY CULTURE	-	-	MP N° 1: SAFETY CULTURE, COMMITMENT & MANAGERIAL RESPONSIBILITY	GUIDELINE 1 – LEADERSHIP & ACCOUNTABILITY	-
	STANDARDS, CODES, REGULATIONS & LAWS	-	-	-	GUIDELINE 2 – REGULATORY COMPLIANCE	-
	PROCESS SAFETY COMPETENCY	-	-	-	GUIDELINE 8 – TRAINING, EDUCATION & AWARENESS	-
	WORKFORCE INVOLVEMENT	-	-	MP N° 2: WORKFORCE COMMITMENT	GUIDELINE 1 – LEADERSHIP & ACCOUNTABILITY	ORGANISATION & PERSONNEL - ANNEX III (I)
	STAKEHOLDERS OUTREACH	ART. 16	-	-	GUIDELINE 10 – COMMUNICATION & GUIDELINE 12 – COMMUNITY RELATIONS	NOTIFICATION - ARTICLE 7
UNDERSTAND HAZARDS AND EVALUATE RISK	PROCESS KNOWLEDGE MANAGEMENT	ART. 8	PROCESS SAFETY INFORMATION	MP N° 8: INFORMATION MANAGEMENT & DOCUMENTATION	GUIDELINE 9 – INFORMATION MANAGEMENT	SAFETY REPORT - ARTICLE 10
	HAZARD IDENTIFICATION & RISK ANALYSIS	ART. 7 & 9	PROCESS HAZARD ANALYSIS	MP N° 12: RISK IDENTIFICATION & RISK ANALYSIS;	GUIDELINE 3 – RISK EVALUATION & MANAGEMENT	IDENTIFICATION & EVALUATION OF MAJOR HAZARDS - ARTICLE 9, 10 & ANNEX III (II)
MANAGE RISK	OPERATING PROCEDURES	ART. 21	OPERATING PROCEDURES & PRE-START-UP SAFETY REVIEW	MP N° 15: OPERATIONAL PROCEDURES	GUIDELINE 5 – OPERATION & MAINTENANCE:	OPERATIONAL CONTROL - ANNEX III (III)
	SAFE WORK PRACTICES	-	SAFE WORK PRACTICES	MP N° 17: SAFE WORK PRACTICE & CONTROL PROCEDURES IN SPECIAL ACTIV.	-	OPERATIONAL CONTROL - ANNEX III (III)
	ASSET INTEGRITY & RELIABILITY	ART. 9(C)	ASSURING QUALITY & MECHANICAL INTEGRITY OF CRITICAL EQUIPMENT	MP N° 11: CRITICAL ELEMENTS OF OPERATIONAL SAFETY & MP N° 13: MECHANICAL INTEGRITY	GUIDELINE 5 – OPERATION & MAINTENANCE	INSPECTIONS (INCLUDING MECHANICAL INTEGRITY) - ARTICLE 20
	CONTRACTOR MANAGEMENT	ART. 9(C)	-	MP N° 5: SELECTION, CONTROL & MANAGEMENT OF CONTRACTORS	GUIDELINE 7 - ACQUISITION OF GOODS & SERVICES	-
	TRAINING & PERFORMANCE ASSURANCE	ART. 9(C)	TRAINING	MP N° 3: QUALIFICATION, TRAINING & PERSONAL PERFORMANCE	GUIDELINE 8 – TRAINING, EDUCATION & AWARENESS	-
	MANAGEMENT OF CHANGE	-	MANAGEMENT OF CHANGE	MP N° 16: MANAGEMENT OF CHANGE	GUIDELINE 6 – MANAGEMENT OF CHANGE	MANAGEMENT OF CHANGE - ARTICLE 11 & ANNEX III (IV)
	OPERATIONAL READINESS	-	-	-	-	-
	CONDUCT OF OPERATIONS	-	-	-	GUIDELINE 5 – OPERATION & MAINTENANCE	-
	EMERGENCY MANAGEMENT	ART. 9(D/ E)	EMERGENCY RESPONSE & CONTROL	MP N° 14: PLANNING & MANAGEMENT OF MAJOR EMERGENCIES	GUIDELINE 11 – CONTINGENCY	PLANNING FOR EMERGENCIES - ANNEX III (V)
	INCIDENT INVESTIGATION	ART. 9(G), 13 & 14	INVESTIGATION OF PROCESS-RELATED INCIDENTS	MP N° 9: INCIDENT INVESTIGATION	GUIDELINE 13 – ACCIDENTS & INCIDENTS ANALYSIS	MONITORING PERFORMANCE - ANNEX III(VI)
LEARN FROM EXPERIENCE	MEASUREMENT & METRICS	-	-	MP N° 6: MONITORING & CONTINUOUS PERFORMANCE IMPROVEMENT	GUIDELINE 15 - ASSESSMENT & CONTINUOUS IMPROVEMENT	MONITORING PERFORMANCE - ANNEX III(VI)
	AUDITING	ART. 18	AUDIT OF PROCESS HAZARDS MANAGEMENT SYSTEMS	MP N° 7: AUDITING	GUIDELINE 15 - ASSESSMENT & CONTINUOUS IMPROVEMENT	AUDIT & REVIEW - ANNEX III (VII)
	MANAGEMENT REVIEW & CONTINUOUS IMPROVEMENT	-	-	MP N° 6: MONITORING & CONTINUOUS PERFORMANCE IMPROVEMENT	GUIDELINE 15 - ASSESSMENT & CONTINUOUS IMPROVEMENT	MONITORING PERFORMANCE - ANNEX III (VI)

Learning from experience gives great importance on incident investigation and is present in all management systems evaluated. Measurement and metrics are present only on CCPS, ANP, Petrobras' HSE and Seveso III, also on these Management Review and Continuous Improvement is an item of great importance to improve the safety systems and the safety conditions. On the other hand, Auditing is present on ILO, API RP 750, ANP, Petrobras and Seveso III and its results also improve the safety systems and the safety conditions.

Policy is present only in Seveso III and Petrobras' HSE management system (Table 2). On the latter, each organizational unit has its own HSE policies, which always comply with the company's HSE guidelines. Other items that were not classified by the frame of CCPS system were: ANP Management Practice nº4: Working Environment and Human Factors; ANP Management Practice nº 10 – Design, Construction, Installation and Decommissioning; Petrobras Guideline 4 – New Projects; and Petrobras Guideline 14 – Product Stewardship.

Table 2: Items not included in CCPS Management System

ITEM	CCPS	OIT	API RP 750	ANP	PETROBRAS	SEVESO III
POLICY / STATEMENTS	-	-	-	-	HSE POLICY OF EACH ORGANIZATIONAL UNIT	MAJOR ACCIDENT PREVENTION POLICY (MAPP) - ARTICLE 8
OTHERS	-	-	-	MP Nº 4: WORKING ENVIRONMENT & HUMAN FACTORS & MP Nº 10: DESIGN, CONSTRUCTION, INSTALLATION & DECOMMISSIONING	GUIDELINE 4 – NEW PROJECTS & GUIDELINE 14 - PRODUCT STEWARDSHIP	-

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