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“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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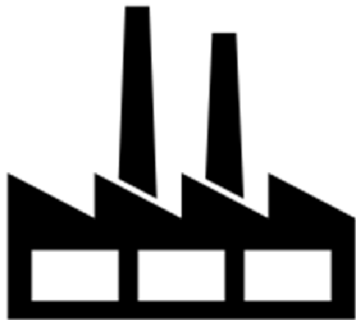
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INTRODUCTION

Global economic growth led to increase sizes of industrial plants. In the 1960s, an industrial plant that produced 50 thousand tons/year of ethylene was considered large. From the 1980s plants the production of ethylene exceeded 1 million tons/year (FREITAS, PORTO and MACHADO, 2000).



1960s



1980s

INTRODUCTION

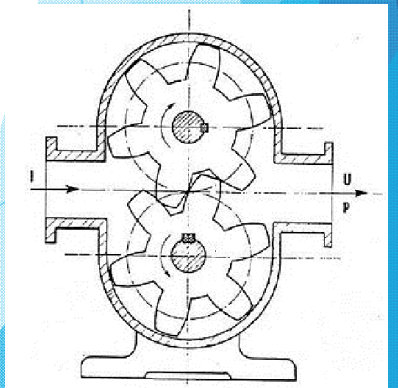
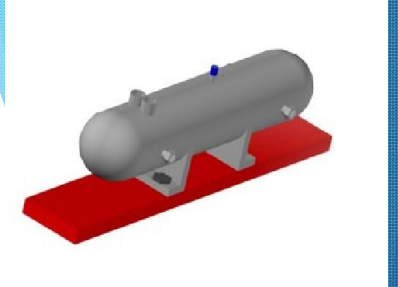
- Opening of new consumer markets
- Globalization
- Stiffer competition
- Technological changes
- The need to increase production



Lead to major Changes in the means of production:

- Increasing of production efficiency
- Production of large volumes under more hostile conditions
(higher pressure, temperature and flow rates)
- Reduced time for maintenance

= Higher risk of accident which can cause irreparable environmental and/or social losses



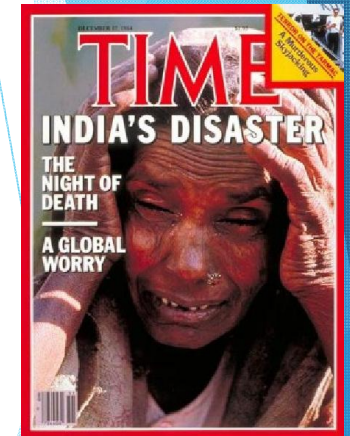
INTRODUCTION

Process incidents – major accidents:

- Seveso 1976 - spill of several pounds of dioxin (2,3,7,8-tetrachlorodibenzo-*p*-dioxin)
- Bhopal 1984 – leak of 40 tons of methyl isocyanate
- Offshore oil and gas industry:
 - Piper Alpha 1988
 - Exxon Valdez 1989
 - Deepwater Horizon 2010



Source: <http://www.hazmat.co.il/?p=3232>



Source: <http://content.time.com/time>

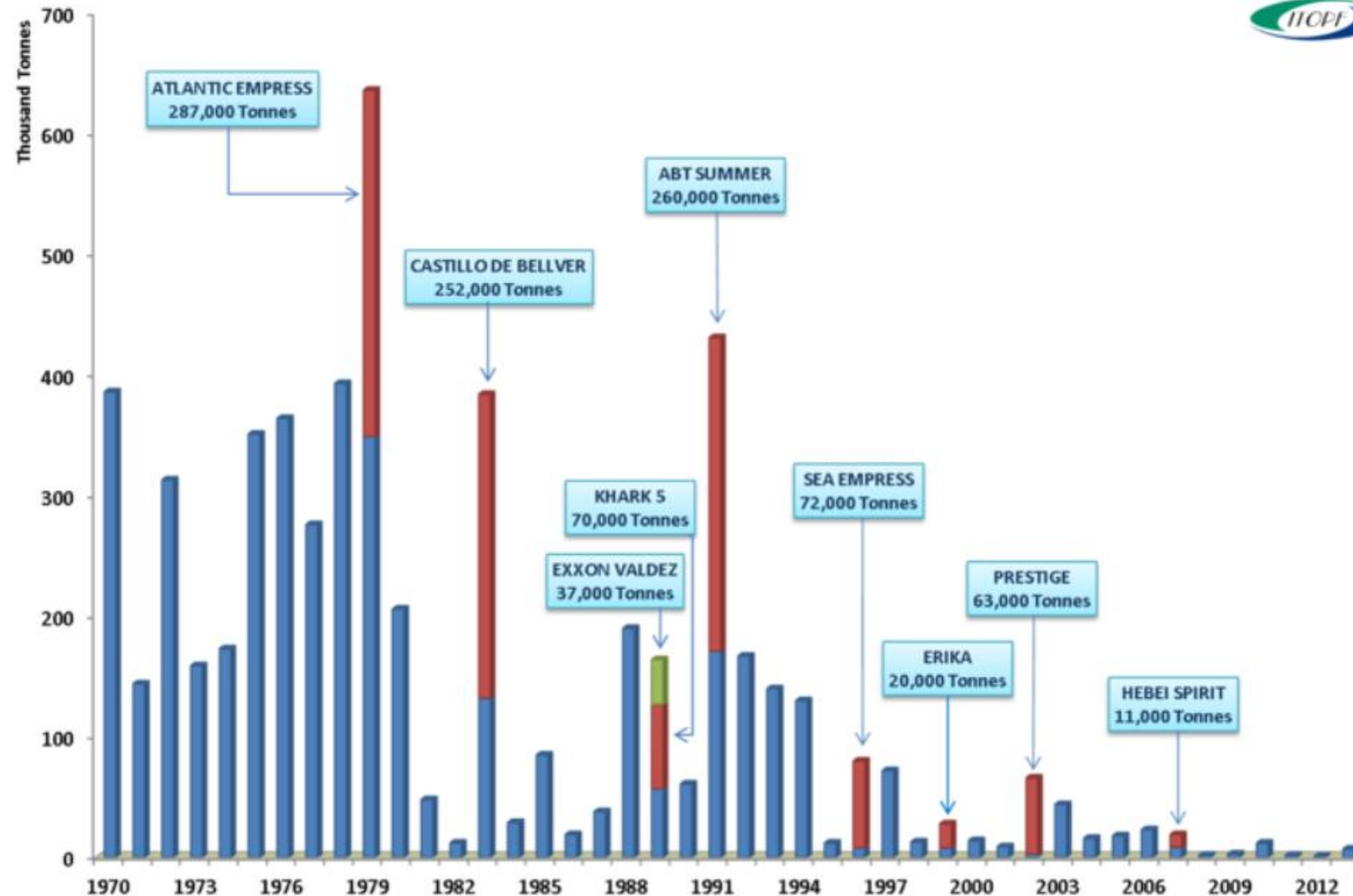


Source: <http://www.theguardian.com/business>

OIL TANKERS LEAKS



Source: <http://www.theguardian.com/world/>



Double hull tankers X U.S Oil Pollution Act 1990

Graph 1 – Ship oil leak in time.

Source: ITOPF - THE INTERNATIONAL TANKER OWNERS POLLUTION FEDERATION LIMITED, 2014.

MOTIVATION

- ▶ To avoid accidents, process industries have to implement preventive and mitigating barriers. That's why regulations, laws, normalizations on process safety have been created.
- ▶ To prevent incidents and losses, a management system can be put in place to reduce the holes (gaps) on the slices (barriers or safeguards), also new slices can be put in place to prevent or mitigate those losses/incidents.

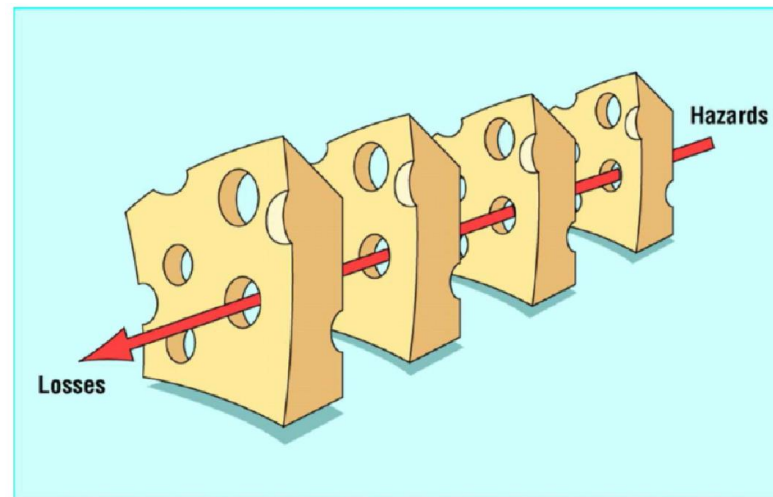


Figure 1 - Swiss cheese model.
Source: REASON, 2007.

OBJECTIVES

- ▶ Assess the main proposals of process safety management systems (PSMS) guidelines
- ▶ Compare them with each other and with the Petrobras' Health, Safety and Environment (HSE) management system.
- ▶ 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.

MATERIAL AND METHOD

1 - Exploratory Research

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). 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.

MATERIAL AND METHOD

2 - Descriptive study

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:

- ▶ Seveso Directive III - **1982**
- ▶ Process safety management of highly hazardous chemicals - OSHA (*Occupational Safety and Health Administration*) - CFR 1910.119 - **1990**
- ▶ *American Petroleum Institute* – API RP 750 - **1990**
- ▶ Process Safety Management System of CCPS (Center for Chemical and Process Safety) - **1992**
- ▶ ILO (International Labour Organization) Convention 174 - **1993**
- ▶ Operational Safety Management System of ANP (Brazilian National Agency of Petroleum, Natural Gas and Biofuels) - **2007**

MATERIAL AND METHOD

3 - Case study

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.

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.

RESULTS AND CONCLUSIONS

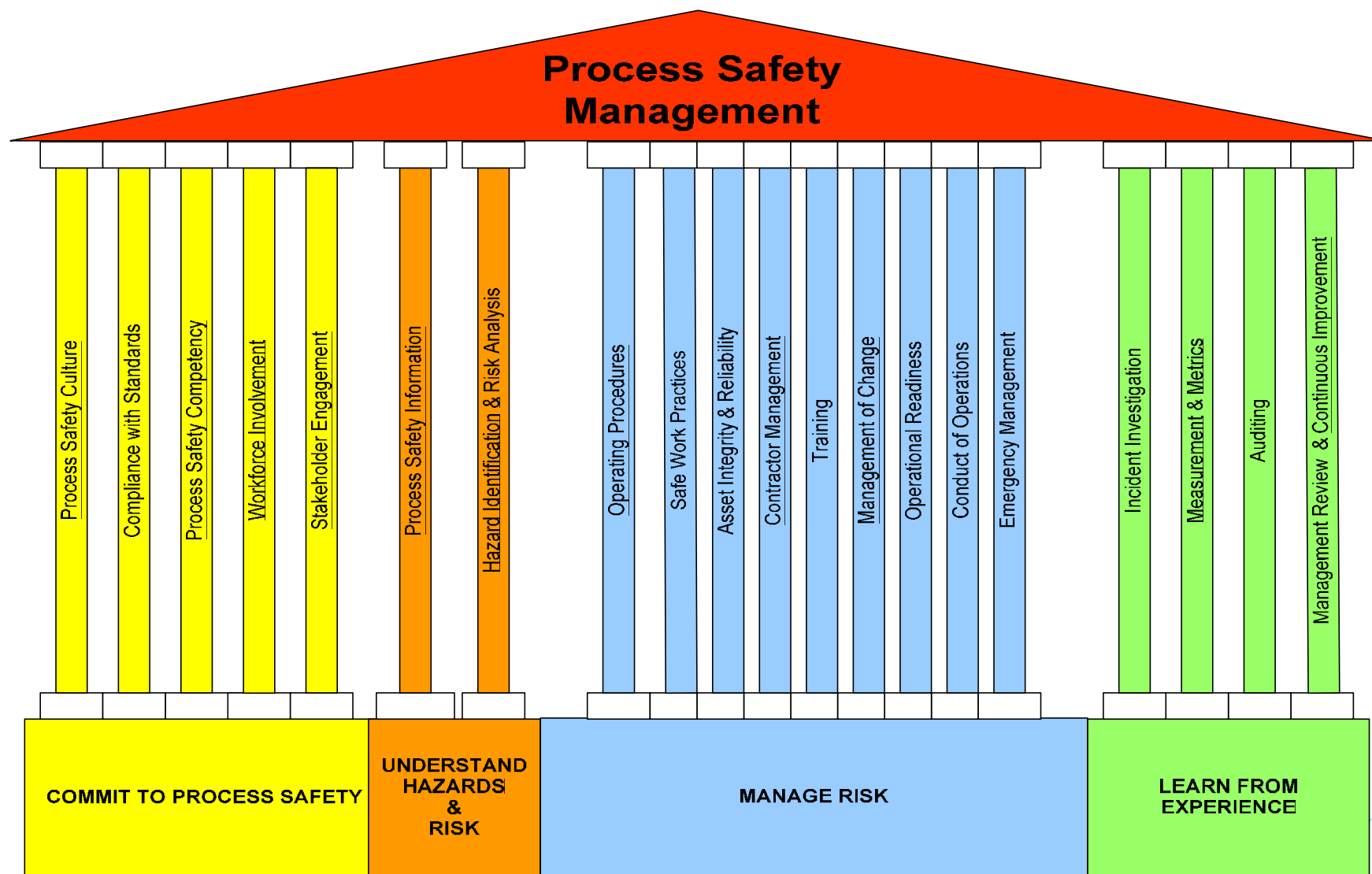


Figure 2 - Elements and blocks proposed by CCPS.

Source: www.aiche.org/cep

RESULTS AND CONCLUSIONS

MANAGEMENT FUNCTION - ACCORDING TO CCPS	CCPS	ILO	API RP 750	OSHA	ANP	SEVESO III	PETROBRAS
COMMITMENT TO PROCESS SAFETY	PROCESS SAFETY CULTURE	-	-	-	MANAGEMENT PRACTICE Nº 1: SAFETY CULTURE, COMMITMENT AND MANAGERIAL RESPONSIBILITY	-	GUIDELINE 1 - LEADERSHIP AND ACCOUNTABILITY
	STANDARDS, CODES, REGULATIONS AND LAWS	-	-	-	-	-	GUIDELINE 2 - REGULATORY COMPLIANCE
	PROCESS SAFETY COMPETENCY	-	-	-	-	-	GUIDELINE 8 - TRAINING, EDUCATION AND AWARENESS
	WORKFORCE INVOLVMENT	-	-	C. EMPLOYEE PARTICIPATION	MANAGEMENT PRACTICE Nº 2: WORKFORCE COMMITMENT	ORGANISATION AND PERSONNEL - ANNEX III (I)	GUIDELINE 1 - LEADERSHIP AND ACCOUNTABILITY
	STAKEHOLDERS OUTREACH	ARTICLE 16	-	-	-	NOTIFICATION - ARTICLE 7	GUIDELINE 10 - COMMUNICATION GUIDELINE 12 - COMMUNITY RELATIONS

RESULTS AND CONCLUSIONS

MANAGEMENT FUNCTION - ACCORDING TO CCPS	CCPS	ILO	API RP 750	OSHA	ANP	SEVESO III	PETROBRAS
UNDERSTAND HAZARDS AND EVALUATE RISK	PROCESS KNOWLEDGE MANAGEMENT	ARTICLE 8	PROCESS SAFETY INFORMATION	D. PROCESS SAFETY INFORMATION	MANAGEMENT PRACTICE Nº 8: INFORMATION MANAGEMENT AND DOCUMENTATION; AND	SAFETY REPORT - ARTICLE 10	GUIDELINE 9 - INFORMATION MANAGEMENT
	HAZARD IDENTIFICATION AND RISK ANALYSIS	ARTICLE 7, ARTICLE 9	PROCESS HAZARD ANALYSIS	E. PROCESS HAZARD ANALYSIS	MANAGEMENT PRACTICE Nº 12: RISK IDENTIFICATION AND RISK ANALYSIS	IDENTIFICATION AND EVALUATION OF MAJOR HAZARDS - ARTICLE 9, 10 AND ANNEX III (II)	GUIDELINE 3 - RISK EVALUATION AND MANAGEMENT

RESULTS AND CONCLUSIONS

MANAGEMENT FUNCTION - ACCORDING TO CCPS	CCPS	ILO	API RP 750	OSHA	ANP	SEVESO III	PETROBRAS
MANAGE RISK	OPERATING PROCEDURES	ARTICLE 21	OPERATING PROCEDURES PRE-START-UP SAFETY REVIEW	F. OPERATING PROCEDURES I. PRE-STARTUP SAFETY REVIEW	MANAGEMENT PRACTICE Nº 15 OPERATIONAL PROCEDURES;	OPERATIONAL CONTROL - ANNEX III (III)	GUIDELINE 5 - OPERATION AND MAINTENANCE
	SAFE WORK PRACTICES	-	SAFE WORK PRACTICES	K. HOT WORK PERMITS	MANAGEMENT PRACTICE Nº 17: SAFE WORK PRACTICE AND CONTROL PROCEDURES IN SPECIAL ACTIVITIES.	OPERATIONAL CONTROL - ANNEX III (III)	-
	ASSET INTEGRITY AND RELIABILITY	ARTICLE 9 (C)	ASSURING THE QUALITY AND MECHANICAL INTEGRITY OF CRITICAL EQUIPMENT	J. MECHANICAL INTEGRITY	MANAGEMENT PRACTICE Nº 11: CRITICAL ELEMENTS OF OPERATIONAL SAFETY; MANAGEMENT PRACTICE Nº 13: MECHANICAL INTEGRITY;	INSPECTIONS (INCLUDING MECHANICAL INTEGRITY) - ARTICLE 20	GUIDELINE 5 - OPERATION AND MAINTENANCE
	CONTRACTOR MANAGEMENT	ARTICLE 9 (C)	-	H. CONTRACTORS	MANAGEMENT PRACTICE Nº 5: SELECTION, CONTROL AND MANAGEMENT OF CONTRACTORS	-	GUIDELINE 7 - ACQUISITION OF GOODS AND SERVICES
	TRAINING AND PERFORMANCE ASSURANCE	ARTICLE 9 (C)	TRAINING	G. TRAINING	MANAGEMENT PRACTICE Nº 3: QUALIFICATION, TRAINING AND PERSONAL PERFORMANCE;	-	GUIDELINE 8 - TRAINING, EDUCATION AND AWARENESS
	MANAGEMENT OF CHANGE	-	MANAGEMENT OF CHANGE	L. MANAGEMENT OF CHANGE	MANAGEMENT PRACTICE Nº 16: MANAGEMENT OF CHANGE	MANAGEMENT OF CHANGE - ARTICLE 11 AND ANNEX III (IV)	GUIDELINE 6 - MANAGEMENT OF CHANGE
	OPERATIONAL READINESS	-	-	-	-	-	-
	CONDUCT OF OPERATIONS	-	-	-	-	-	GUIDELINE 5 - OPERATION AND MAINTENANCE
	EMERGENCY MANAGEMENT	ARTICLE 9 (D), (E)	EMERGENCY RESPONSE AND CONTROL	N. EMERGENCY PLANNING AND RESPONSE	MANAGEMENT PRACTICE Nº 14: PLANNING AND MANAGEMENT OF MAJOR EMERGENCIES	PLANNING FOR EMERGENCIES - ANNEX III (V)	GUIDELINE 11 - CONTINGENCY

RESULTS AND CONCLUSIONS

MANAGEMENT FUNCTION - ACCORDING TO CCPS	CCPS	ILO	API RP 750	OSHA	ANP	SEVESO III	PETROBRAS
LEARN FROM EXPERIENCE	INCIDENT INVESTIGATION	ARTICLE 9 (G) , ARTICLE 13 AND ARTICLE 14	INVESTIGATION OF PROCESS- RELATED INCIDENTS	M. INCIDENT INVESTIGATION	MANAGEMENT PRACTICE N° 9: INCIDENT INVESTIGATION.	MONITORING PERFORMANCE - ANNEX III(VI)	GUIDELINE 13 - ACCIDENTS AND INCIDENTS ANALYSIS
	MEASUREMENT AND METRICS				MANAGEMENT PRACTICE N° 6: MONITORING AND CONTINUOUS PERFORMANCE IMPROVEMENT;	MONITORING PERFORMANCE - ANNEX III(VI)	GUIDELINE 15 - ASSESSMENT AND CONTINUOUS IMPROVEMENT
	AUDITING	ARTICLE 18	AUDIT OF PROCESS HAZARDS MANAGEMENT SYSTEMS		MANAGEMENT PRACTICE N° 7: AUDITING;	AUDIT AND REVIEW - ANNEX III (VII)	GUIDELINE 15 - ASSESSMENT AND CONTINUOUS IMPROVEMENT
	MANAGEMENT REVIEW AND CONTINUOUS IMPROVEMENT				MANAGEMENT PRACTICE N° 6: MONITORING AND CONTINUOUS PERFORMANCE IMPROVEMENT;	MONITORING PERFORMANCE - ANNEX III (VI)	GUIDELINE 15 - ASSESSMENT AND CONTINUOUS IMPROVEMENT

RESULTS AND CONCLUSIONS

ITEM NOT INCLUDED ON CCPS MANAGEMENT SYSTEM	CCPS	OIT	API RP 750	OSHA	ANP	SEVESO III	PETROBRAS
POLICY / STATEMENTS	-	-	-	A. PURPOSE B. APPLICATION DEFINITIONS	-	MAJOR ACCIDENT PREVENTION POLICY (MAPP) - ARTICLE 8	HSE POLICY OF EACH ORGANIZATIONAL UNIT
OTHERS	-	-	-	-	MANAGEMENT PRACTICE Nº 4: WORKING ENVIRONMENT AND HUMAN FACTORS; MANAGEMENT PRACTICE Nº 10: DESIGN, CONSTRUCTION, INSTALLATION AND DECOMMISSIONING;	-	GUIDELINE 4 - NEW PROJECTS GUIDELINE 14 - PRODUCT STEWARDSHIP

DISCUSSION AND CONCLUSION

A greater importance is given by all PSM guidelines to those items presented in the Block “Understand and Evaluate Hazards Risk”, which emphasizes:

- ▶ Knowledge of the Process
- ▶ Hazard Identification and Risk Analysis

These items are essential to identify what can go wrong on the operation 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).

Understand and Evaluate Hazards Risk and Manage Risk are the essential blocks of a PSMS and because of it's importance, it is recommended that *further research* should be directed towards this matter.

DISCUSSION AND CONCLUSION

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.

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.



“ Competent people drive performance. And effective management systems drive sustainability” (MANNAN, 2012, p. 108).