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## **OPERATIONAL MANAGEMENT PRACTICES IN ONSHORE FIELDS TO FULFILL STRUCTURAL INTEGRITY REQUIREMENTS OF THE INSTALLATIONS AND OPERATIONS SAFETY (OIL AND GAS PRODUCERS)**



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# Introduction

- Exploration and production process (E&P), oil and natural gas producing wells and produced water, natural gas and steam injection wells:
  - operating conditions
  - potential hazards & main problems
- Oil and natural gas producing fields must carry out:
  - risk studies and meet the requirements defined by the National Petroleum Agency (ANP); and
  - ISO 9001:2015 (QMS); ISO 14001:2015 (EMS), and ISO 45001:2018 (SHMS).

## Research goal

Carry out a comparative analysis of operational management practices in onshore oil and natural gas producing fields to meet the requirements of the SGI: ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 and technical regulations of operational safety management systems (RTSGSO) and structural integrity of producers well and injector well installations (RTSGI and RTSGIP), defined by the National Petroleum Agency (ANP) in Brazil.

# Literature review

- Contextualization of Oil Exploration and Production (E&P) in Brazil



Production well



Injection well



Ducts / Piping

- ISO standards of management systems integration (MSI): ISO 9001:2015; ISO 14001:2015 and ISO 45001:2018
- Technical regulations for operational safety management systems (RTSGSO), structural integrity of facilities (RTSGI) and integrity of wells (RTSGIP) and the 17 Management Practices (MP)

# Literature review continued

## ANP Resolution No. 43/2016

### Technical Regulation of the Onshore Well Integrity Management System (RTSGIP) for the Production of Oil and Natural Gas

#### Chapter 2: 17 (seventeen) Management Practices (MP)

MP n° 1: Culture of Safety, Commitment and Managerial Responsibility

MP n° 2: Involvement of the Workforce

MP n° 3: Skills Management

MP n° 4: Human Factors

MP n° 5: Selection, Control and Management of Contracted Companies

MP n° 6: Monitoring and Continuous Improvement of Performance

MP n° 7: Audits

MP n° 8: Information and Documentation Management

MP n° 9: Incidents

MP n° 10: Well Life Cycle Stages

MP n° 11: Critical Elements of Well Integrity

MP n° 12: Risk Analysis

MP n° 13: Well Integrity

MP n° 14: Well Control Emergency Planning and Management

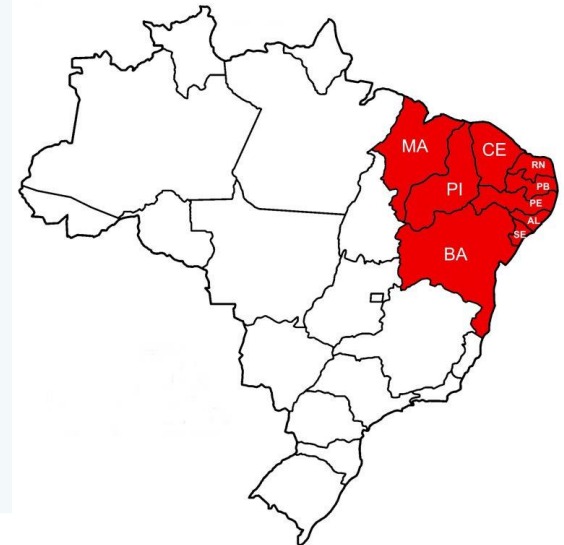
MP n° 15: Procedures

MP n° 16: Management and Changes

MP n° 17: Environmental Preservation

# Methodology

- Exploratory and descriptive research with a mix approach (qualitative and quantitative)
- Research Strategies: bibliographic and documentary
- Multi-cases study method in five oil and natural gas producing fields, located in northeastern Brazil, classified as: field "A"; "B"; "C"; "D" and "E".



# Data gathering

About technical documentation of the installation; management and transfer of knowledge for the training of the own operation technicians and contracted operators; operational safety and integrity of facilities;

Applied to a Total of 50 (fifty) oil and natural gas producing wells, and produced water injection wells (PIW), from five producing fields: "A"; "B"; "C"; "D" and "E", with verification of 10 (ten) wells per producing field;

The checklists had a total of 97 closed questions structured in 2 (two) CLs, with the following answer options "C - conform"; "NC - not conform" and "NA - not applicable", structured into 2 (two) categories:

- Category A-KTM for assessment of management and transfer of knowledge to employees own and contractors with 35 closed questions; and
- Category B-PIW for verification of the integrity of Facilities and equipment and safety of the operations of oil producing wells and fluid injectors, with 62 closed questions, applied by 5 (five) contracted operators; and applied SPSS version 22.

## **Applied data collection instrument: checklists (CLs) in loco**

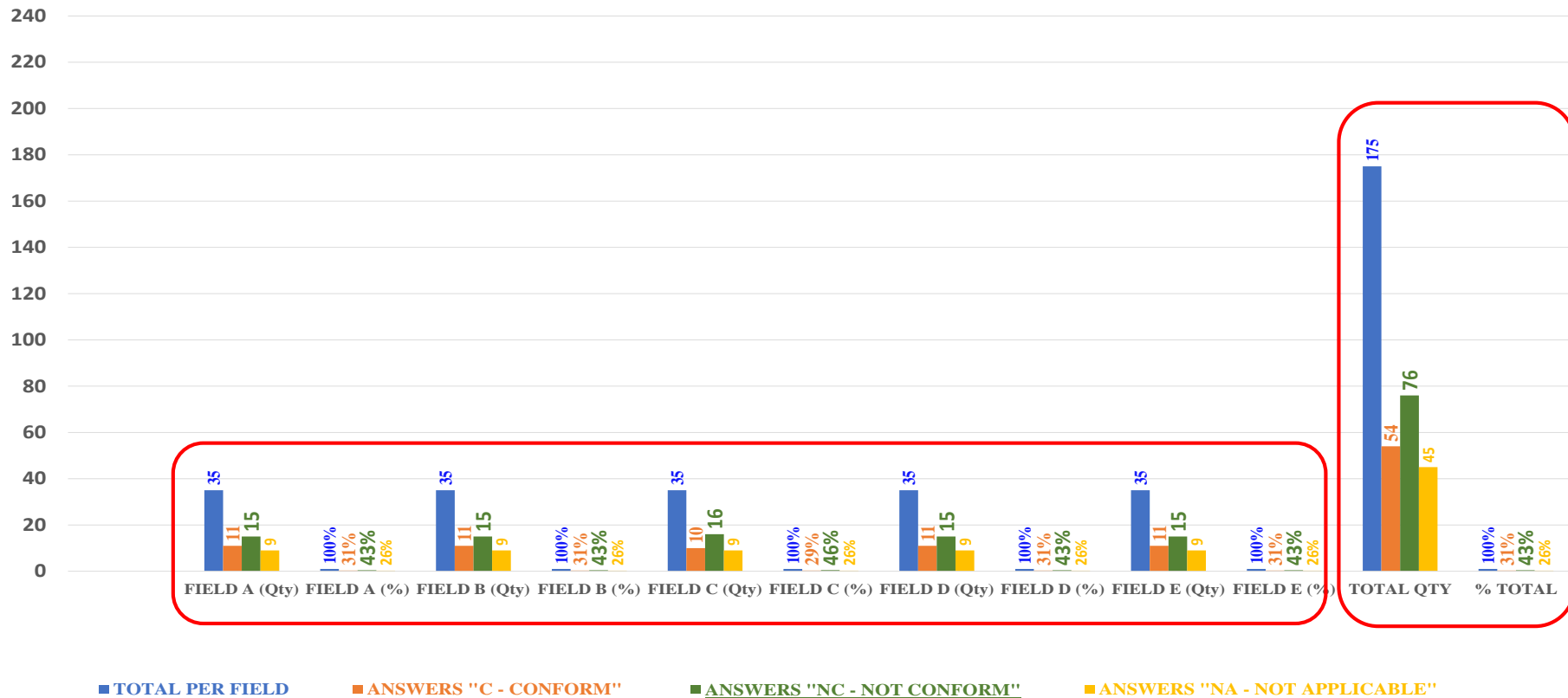
# **Results of Management Practices Category A-KMT**

Application of on-site checklists of the five oil and natural gas producing fields "A", "B", "C", "D" and "E" we observed a general total of 175 responses in category A-KMT on knowledge management and transfer and an overall average of 35 responses per producer field

We counted the overall total of 76 (43%) "not conform" responses, 54 (31%) "conform" and 45 (26%) "not applicable" responses. By producer field, we verified an average of 15 (44%) "not conform" responses, 11 (30%) "conform" responses and 9 "not applicable" responses (Fig. 1).

# Results – Category A-KTM

QUANTITATIVES AND PERCENTAGE VALUES OF THE RESPONSES OF THE IN LOCO CHECKLIST ON KNOWLEDGE MANAGEMENT AND TRANSFER TO OWN AND CONTRACTED EMPLOYEES (KMT) BY PRODUCTION FIELD A, B, C, D, E AND TOTAL GENERAL



In this context, we highlight as variables of greatest concern and relevance the high percentage values of the "not conform" responses, as they were systemic in all the researched producing Fields.

# Results – Category A-KTM

The variables of category A-KTM with “not conform” responses referring to the management and knowledge transfer requirements for own and contracted employees verified in a systemic way from 5 (five) studied producing fields were:

- KMT 01 Did people change management carried out before the Voluntary Dismissal Program (VDP)?
- KMT 02 Personnel change management serves for knowledge management and transfer?
- KMT 10 Are guideline and execution standards available for consultation at the facility?
- KMT 11 Employees have a key and password to access the standards through the System?
- KMT 12 Contractor's standards are updated based on the contractor's standards?
- KMT 13 Standard Operating Procedures (SOP) of the contractor are printed?
- KMT 14 Standards (SOP) of the contracted company identified the aspects and impacts of Safety, Environment and Health (SEH)?
- KMT 15 Employee has the 10 Golden Rules badge?
- KMT 16 Bulletin and Checklist have traceability with the standard number?
- KMT 17 Training conducted in Operational Safety Documentation - OSD (DLU, Flowcharts; Plants; LCE; APR and HAZOP)?
- KMT 18 Description of Land Unit (DLU) is available for consultation?
- KMT 19 List of Critical Elements (LCE) available for consultation?
- KMT 21 Electrical Area Classification Plant is available for consultation?
- KMT 23 Risk Studies APR and HAZOP are available for consultation?
- KMT 32 Service Pass registered on the intranet system?
- KMT 35 Employees have access to the production control and well test system?

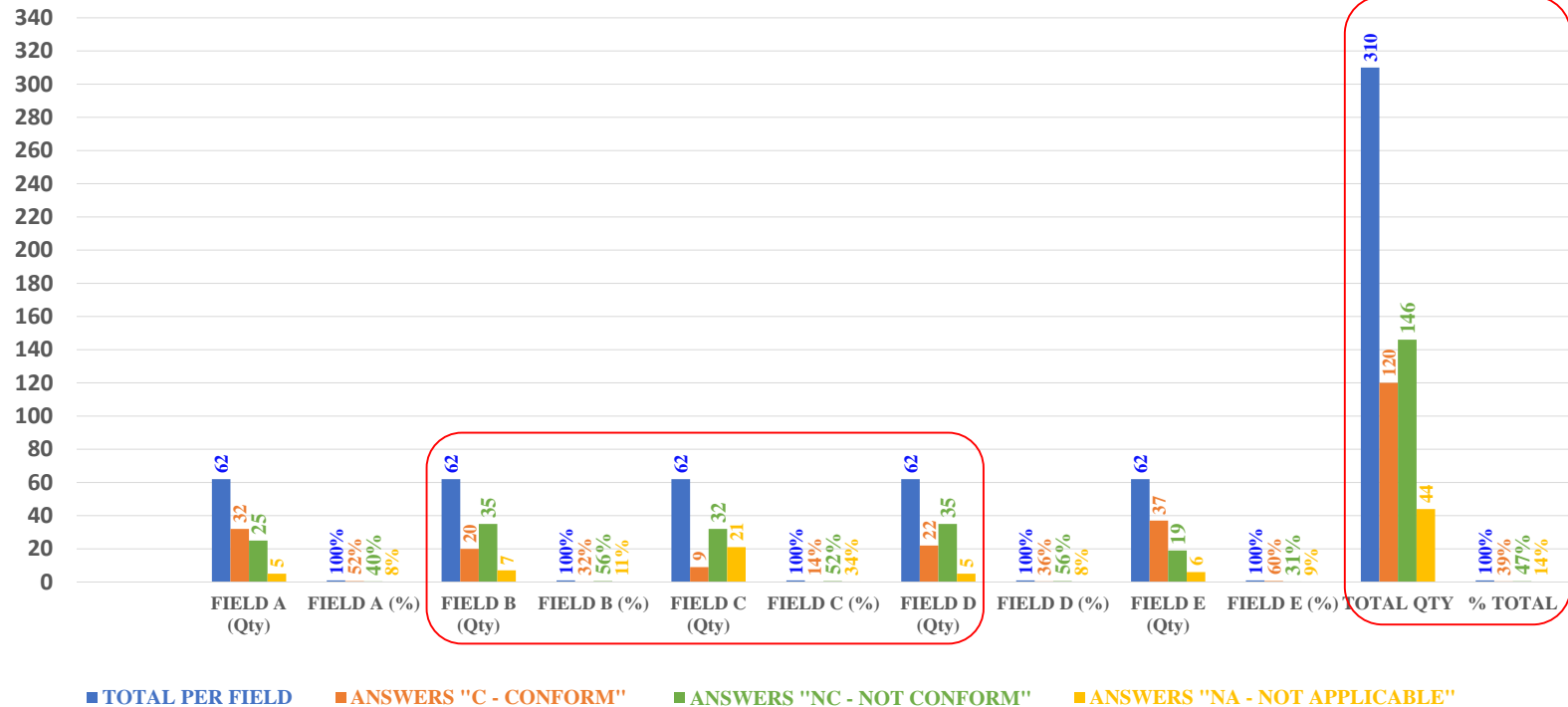
# Results of Management Practices - Category B-PIW

In the results of the on-site checklists with questions of category B-PIW on the integrity of the facilities and operational safety of the producing and injector wells, oil and gas pipelines, water mains, satellites, multiway and accessories of oil producing fields "A"; "B"; "C"; "D" and "E" we verified an overall total of 310 responses and an overall average of 62 responses per producer field, defined in Fig. 2.

We identified a grand total of 146 (47%) "not conform" responses, 120 (39%) "conform" responses and 44 (14%) "not applicable" responses. By producer field, we found in producer fields "B", "C" and "D" an average of 34 (55%) "not conform" responses, producing field "A" with 25 (40%) and "E" with 19 (31%) "not-conform" responses, average of 24 (39%) "conform" responses and average of 9 (14%) "not applicable" responses (Fig. 2).

# Results – Category B-PIW

QUANTITATIVES AND PERCENTAGE VALUES OF THE RESPONSES IN THE LOCAL CHECKLIST ON THE INTEGRITY OF FACILITIES AND THE OPERATIONAL SAFETY OF OIL PRODUCTION WELLS AND FLUID INJECTION (PIW) PER PRODUCTION FIELD A, B, C, D, AND TOTAL



However, we observed important variables of operational safety and integrity of the facilities with high percentages of "not conform" responses, in a systemic way and with greater concern in the "B", "C" and "D" producing fields, and with percentages of lower values, but also relevant in producer fields "A" and "E".

# Results – Category B-PIW

The variables of category B-PIW with more than two "not conform" responses to the requirements related to the structural integrity of the installation and safety of operations identified most frequently in the production wells and injection wells of the studied producing fields were:

- PIW 01 Do the drain valves (Annular and Flow Tee) of well have CAP / PLUG?
- PIW 02 Does the well have an "Out of Operation" or "Under Maintenance" sign?
- PIW 03 Do the rackets have an adhesive / label with technical manufacturing data?
- PIW 04 Do the rackets have a "Racquet" warning sign?
- PIW 05 Flange bolts have leftover thread after the nuts?
- PIW 06 Does the production / injection line have tagging (TAG) / well number?
- PIW 07 Does the production / injection line have signs with a fluid type range?
- PIW 08 Does the production / injection line have a flow direction arrow sign?
- PIW 09 Are well slopes / slopes free from erosion?
- PIW 10 Do well slopes / slopes have erosion protection vegetation?
- PIW 11 Is the well location free from high vegetation?
- PIW 12 Is the forefoot (box) with a low fluid level?
- PIW 13 Is the production line pressure transmitter and indicator (PTI) operational?
- PIW 14 Manometer installed in a well is calibrated and operational?
- PIW 15 Satellite and / or multivia has a cap / plug on the drain valves?
- PIW 16 Are the well automation equipment operational?
- PIW 20 Does the well have a protective grid or cage around the installation?
- PIW 22 Does the well location have a complete fence?
- PIW 23 Does the well lease have a complete gate?
- PIW 24 Is the well installation free from corrosion?
- PIW 25 Installation flanges and well valves have all the screws?
- PIW 26 Is the well lease free of ferrous scrap?
- PIW 27 Is the well lease exempt from open trenches?
- PIW 28 Are the drainage channels intact?
- PIW 29 Are the drainage channels clean and free of vegetation and / or sand?
- PIW 30 Is the well installation free of leaks?
- PIW 31 Satellite and / or multivia has a fence, a closed gate with a padlock?
- PIW 35 Shutoff and / or well drain valve with handwheel has chain with padlock?
- PIW 36 Is the well base free of oily residue?
- PIW 39 Does the well have an identification plate with tagging (TAG) / No. of the well?
- PIW 40 Is the well identification plate intact, with legible data?
- PIW 41 Does the well identification plate have the company's identification?
- PIW 42 Does the well nameplate have risk signs?
- PIW 43 Does the well identification plate have Individual Protection Equipment (IPE) signage?
- PIW 45 Well stopped out of operation does it have rackets?

# Comparative Analysis: Category A-KTM and B-PIW

Categories: A-KTM and B-PIW		Oil Productions Fields										Total by Category	
		A		B		C		D		E			
		QTD	%	QTD	%	QTD	%	QTD	%	QTD	%	QTD	%
A-KTM - Knowledge Transfer and Management	<i>conform</i>	11	31%	11	31%	10	28%	11	31%	11	31%	54	31%
	<i>not conform</i>	<b>15</b>	<b>43%</b>	<b>15</b>	<b>43%</b>	<b>16</b>	<b>46%</b>	<b>15</b>	<b>43%</b>	<b>15</b>	<b>43%</b>	<b>76</b>	<b>43%</b>
	<i>not applicable</i>	9	26%	9	26%	9	26%	9	26%	9	26%	45	26%
Total Category A-KTM		35		35		35		35		35		175	
B-PIW - Integrity of installations and Safety of operations of Production and Injector Wells	<i>conform</i>	32	52%	20	32%	9	14%	22	35%	37	60%	120	39%
	<i>not conform</i>	<b>25</b>	<b>40%</b>	<b>35</b>	<b>57%</b>	<b>32</b>	<b>52%</b>	<b>35</b>	<b>57%</b>	<b>19</b>	<b>31%</b>	<b>146</b>	<b>47%</b>
	<i>not applicable</i>	5	8%	7	11%	21	34%	5	8%	6	9%	44	14%
Total Category B-PIW		62		62		62		62		62		310	
Total by Field and Overall		97		97		97		97		97		485	
Total " <i>conform</i> " - A-KTM and B-PIW		43	45%	31	32%	19	20%	33	34%	48	50%	174	36%
Total " <i>not conform</i> " - A-KTM and B-PIW		<b>40</b>	<b>41%</b>	<b>50</b>	<b>52%</b>	<b>48</b>	<b>49%</b>	<b>50</b>	<b>52%</b>	<b>34</b>	<b>35%</b>	<b>222</b>	<b>46%</b>
Total " <i>not applicable</i> " - A-KTM and B-PIW		14	14%	16	16%	30	31%	14	14%	15	15%	89	18%

(Source: Research Data).

The percentage values of "not conform" responses in the A-KTM category were more critical, as they are systemic in all producing fields. And in category B-PIW, higher percentage values of "non-conforming" responses were identified in producer fields "B"; "C" and "D", characterizing potential risks of "not conform" in internal and / or external audit, for incidents (accidents or near misses), impacts on the environment and health at work.

# Final Remarks

Most of the variables in Category A-KTM on knowledge management and transfer (KTM) for employees and contractors, basis for quality assurance, operational safety, integrity of facilities, environmental preservation and occupational health presented quantitative and percentage values relevant "not conform" variables in all five "A" producer fields; "B"; "C"; "D" and "E".

In category B-PIW on the integrity of facilities and operational safety in producer wells and injector wells (PIW) were verified in producer fields "B"; "C" and "D" higher quantitative values and percentages of "non-compliant" variables with legal requirements, with installations and operational pipelines in uninhabited areas, close to sensitive areas (river, stream, lake, mangroves), oil, gas and water produced with high salinity, exposed to vandalism and theft, risk of leaks, as well as operational safety, integrity of facilities, equipment, people, assets and image of the producing fields.

We observed relevant values of "not conform" variables for the legal requirements identified in Categories A-KTM and Category B-PIW, which required the opening of work orders (OS), as they could characterize million fines applied by the National Petroleum Agency (ANP) in producing fields in Brazil.

# Operational Management Practice Proposals

## Six recommendations

1. Automate all processes and equipment, apply specialized information and communication technology (ICT) systems;
2. Standardize online checklists with digital data collectors (PDA) for facilities, equipment and wells;
3. Structure operational procedures with strong operational management practices, for continuous improvement development;
4. Develop a matrix to increase risk perception of production processes; technical and non-technical courses; normative courses on legal requirements, for the qualification of own and outsourced employees;
5. Develop courses on technical documentation of facilities and processes for producing oil and natural gas; and
6. Develop internal audits and planned periodic inspections using ICT, forms / checklists with digital data collection by PDA, with control and storage in SAP/R3-ERP.