



**Reliability
Dynamics**

Practical application of ISO 14224 methods in corporate software

Tony Ciliberti PE

Principal Engineer, Reliability Dynamics

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ISO 14224 Overview

ISO 14224 Petroleum, petrochemical and natural gas industries —
Collection and exchange of reliability and maintenance data for
equipment

Provides a comprehensive basis for the collection of equipment
reliability and maintenance (RM) data in a standard format

Developed by the Offshore Reliability Database (OREDA) JIP

- OREDA Established 1981, data collection 1983-present
- OREDA widely considered to be the most successful initiative of its type
- OREDA authored the first version of ISO 14224 in 1999 and remains closely involved in development of successive versions



Business Case for ISO 14224

Enables data-driven decision-making with high-quality equipment reliability data

Enables corporate line-of-sight between equipment failure events and the bottom line

Helps companies identify where to focus equipment reliability efforts



We need “data collection principles and associated terms and definitions that constitute a “reliability language” ...for communicating operational experience.”

Attributes of high-quality RM data

- Standard
- Complete
- Coherent
- Structured
- Aggregated at equipment unit
- Accessible



Quality Assurance

- Technical hierarchy incorporates ISO 14224 equipment taxonomy
- Malfunction reporting incorporates ISO 14224 normative specifications and notations
- CMMIS validations ensure ISO 14224 data compliance

Quality control

- Event record reviews
- Results-based feedback/training to field personnel





IDENTIFY

- Equipment failure events with the greatest consequences
- Equipment causing those events (bad-actor equipment)

ANALYZE

- High-consequence failure events
- Failure patterns of bad-actor equipment causing them
- Obtain details necessary to take corrective action

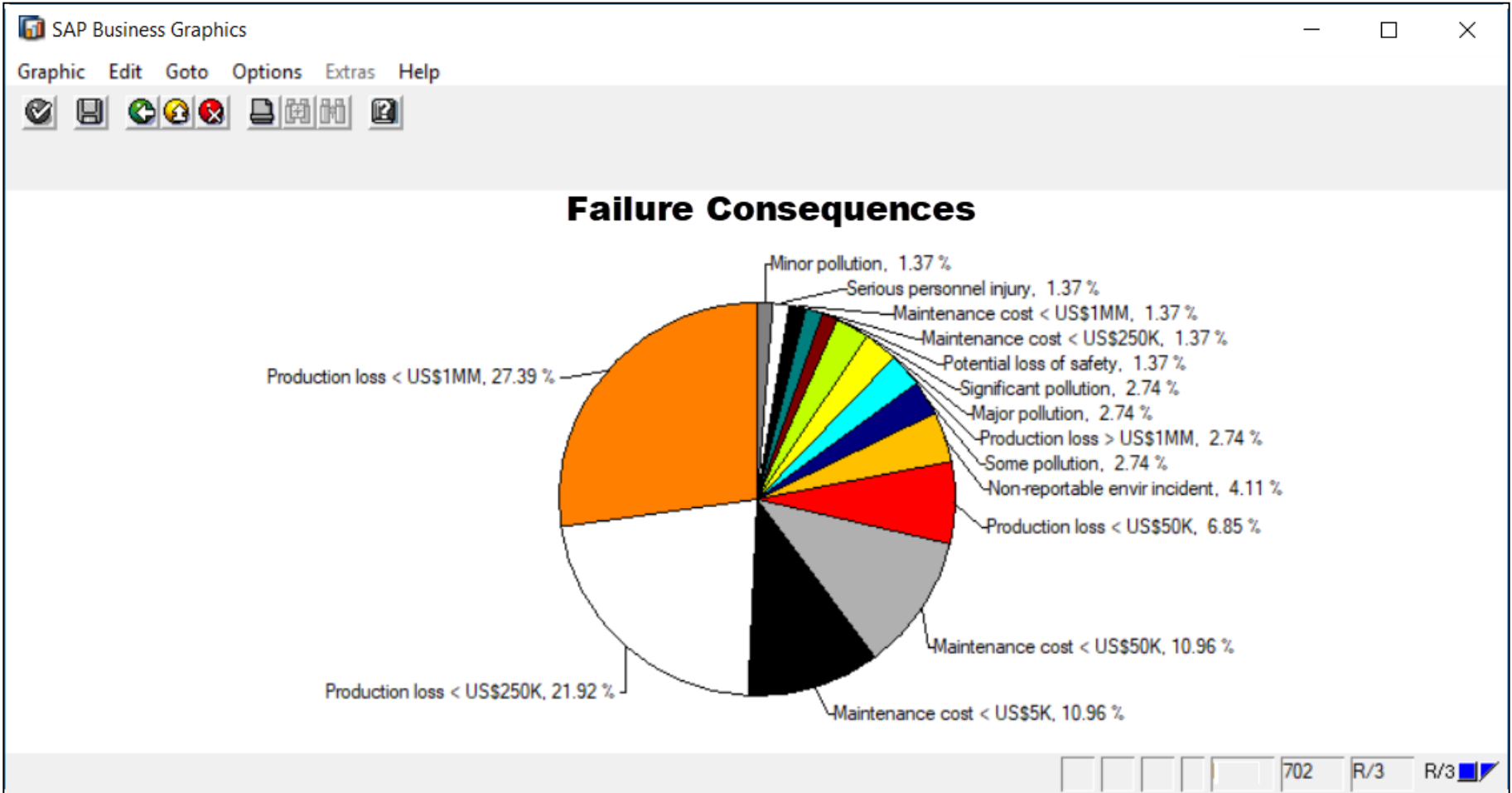
RESOLVE

- Bad actor equipment reliability issues
- Implement and prioritize corrective measures



IDENTIFY High-Consequence Failure Events

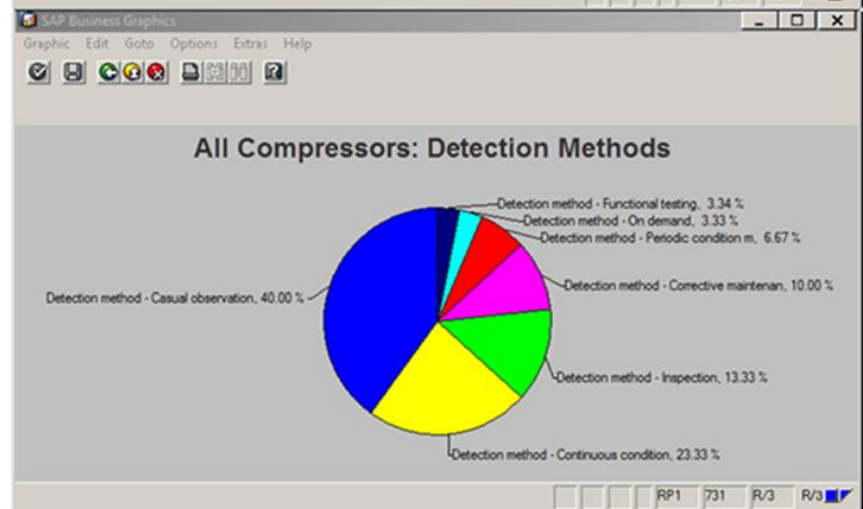
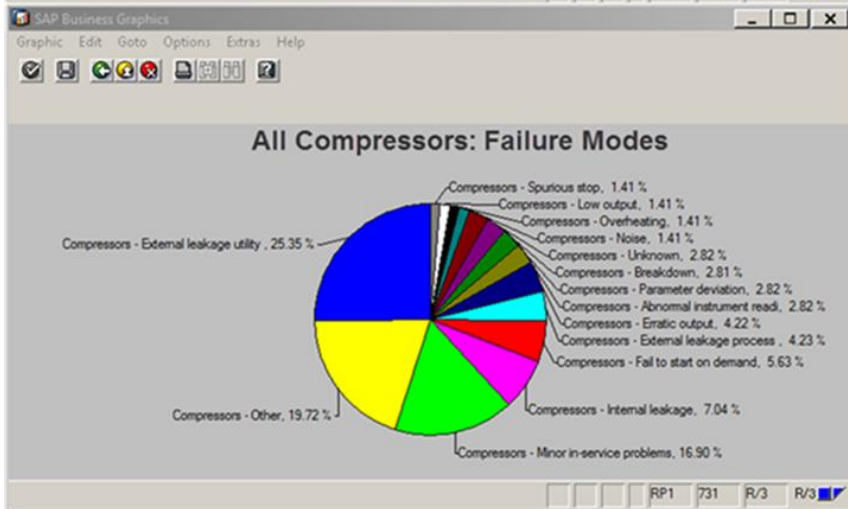
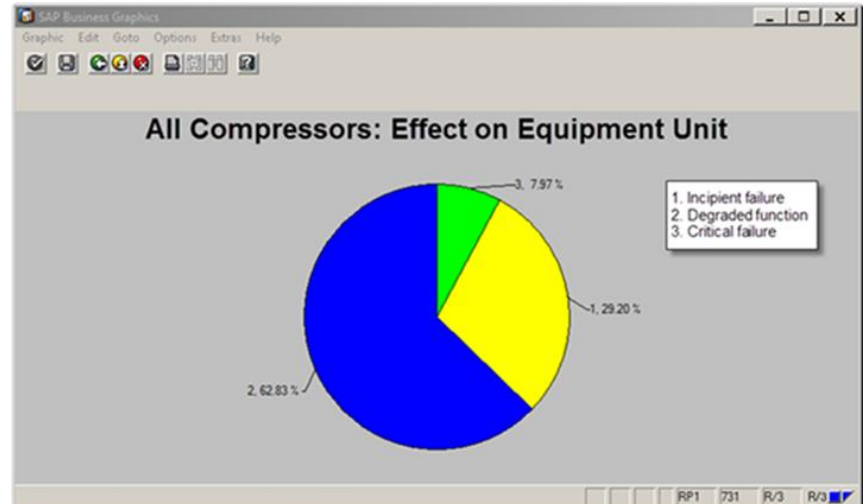
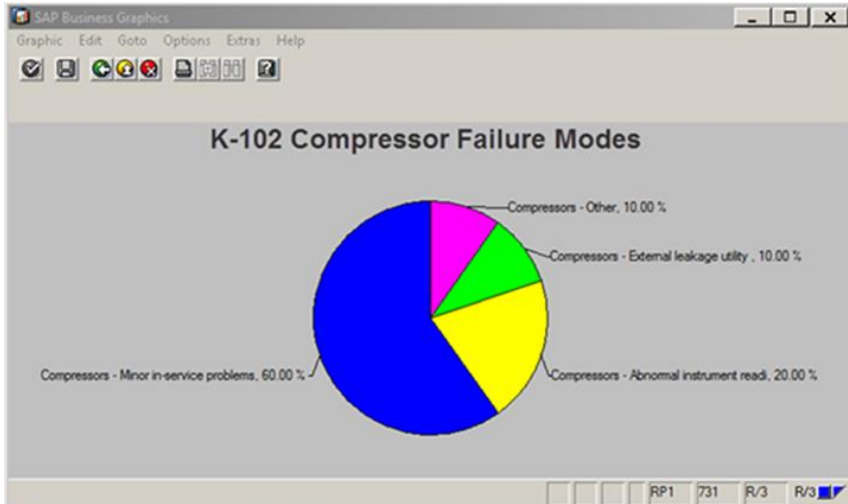
Corporate Metrics





ANALYZE Failure details

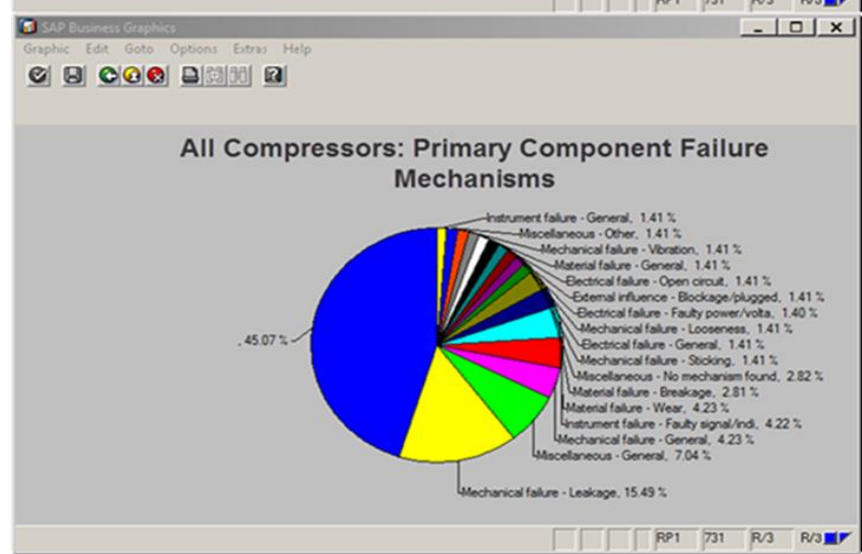
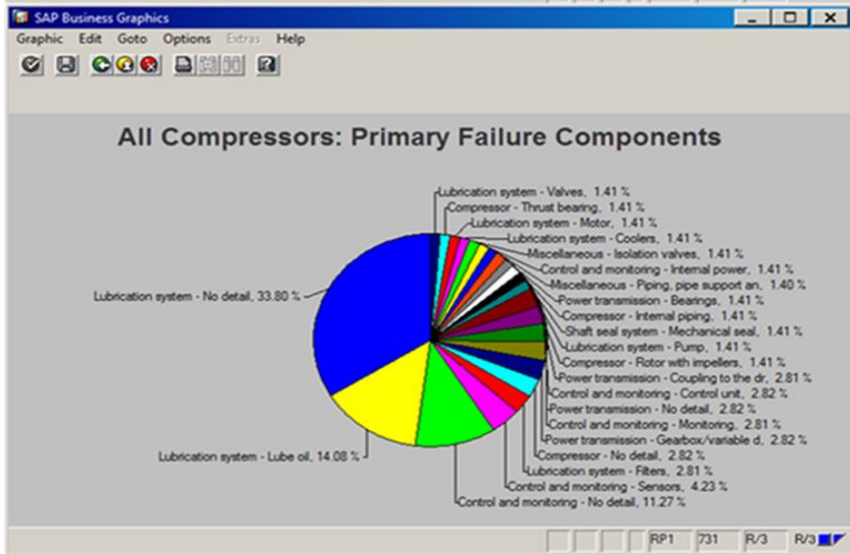
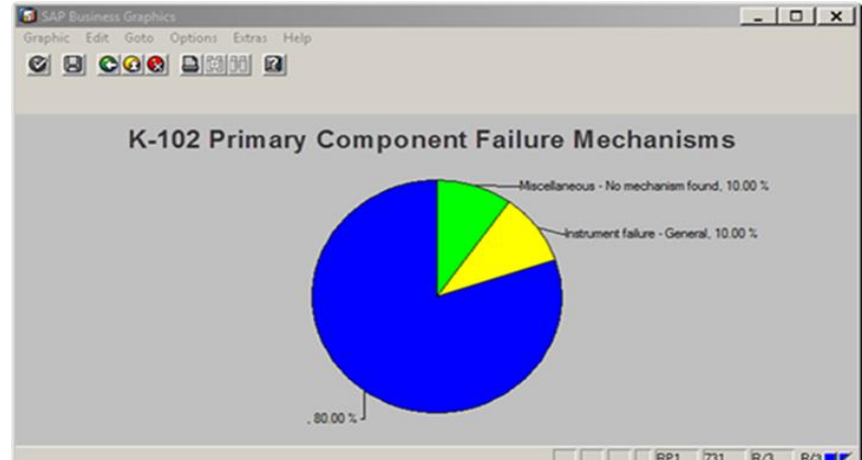
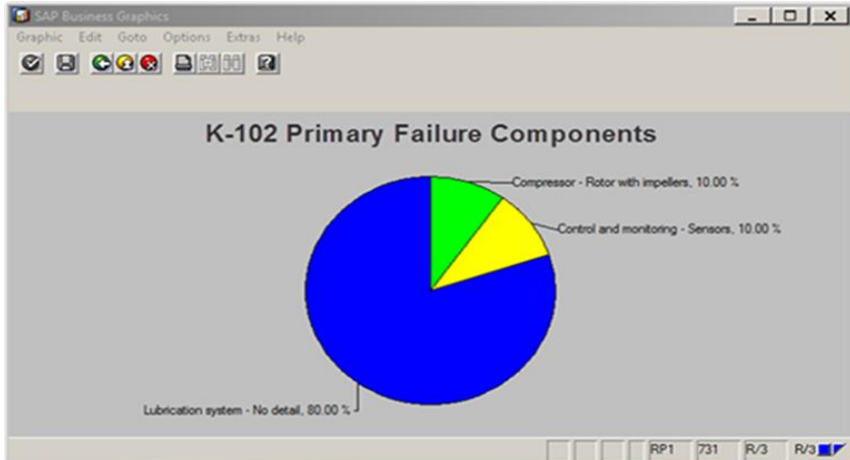
Equipment-Level Analysis





ANALYZE Failure details

Component-Level Analysis





RESOLVE Bad-Actor Equipment Issues

Implement corrective measures for bad actor equipment, e.g.:

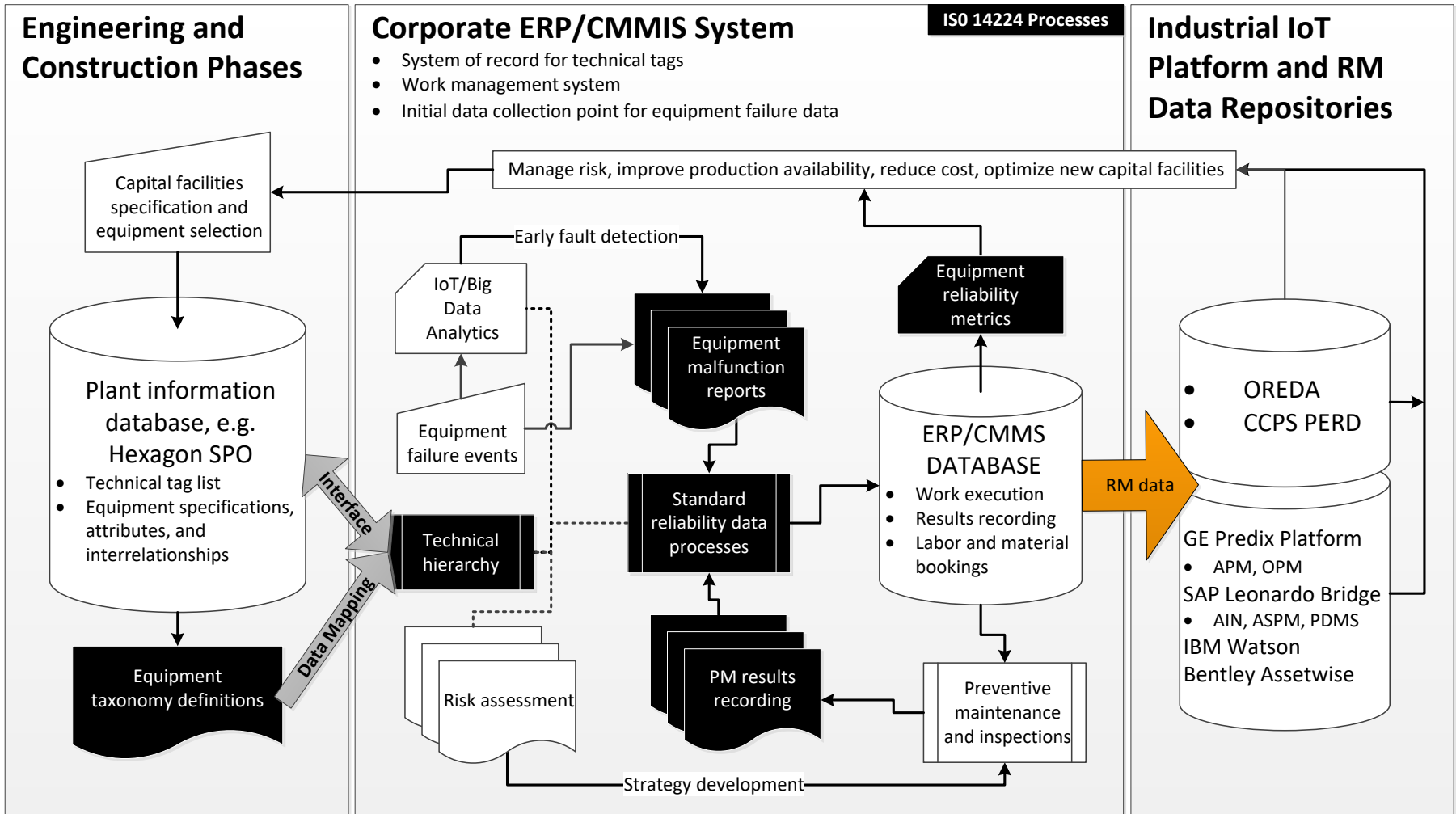
- Preventive maintenance
- Inspections
- Procedures
- Facilities changes

Prioritize corrective measures based on:

- Actual consequences
- Future consequence potential



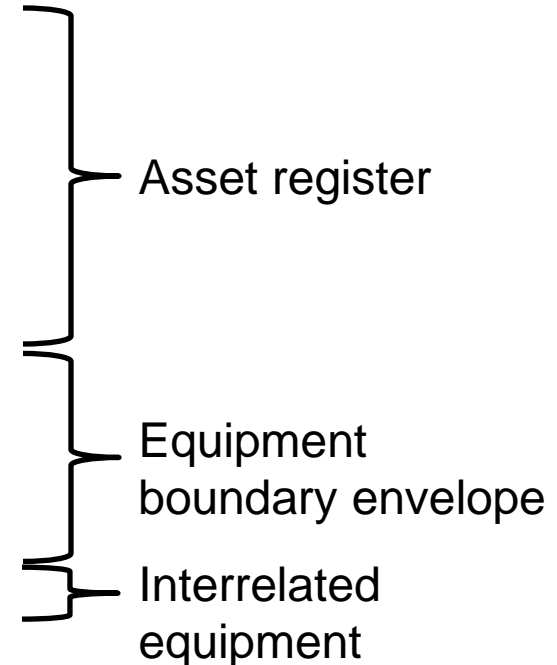
ISO 14224 Solution Landscape





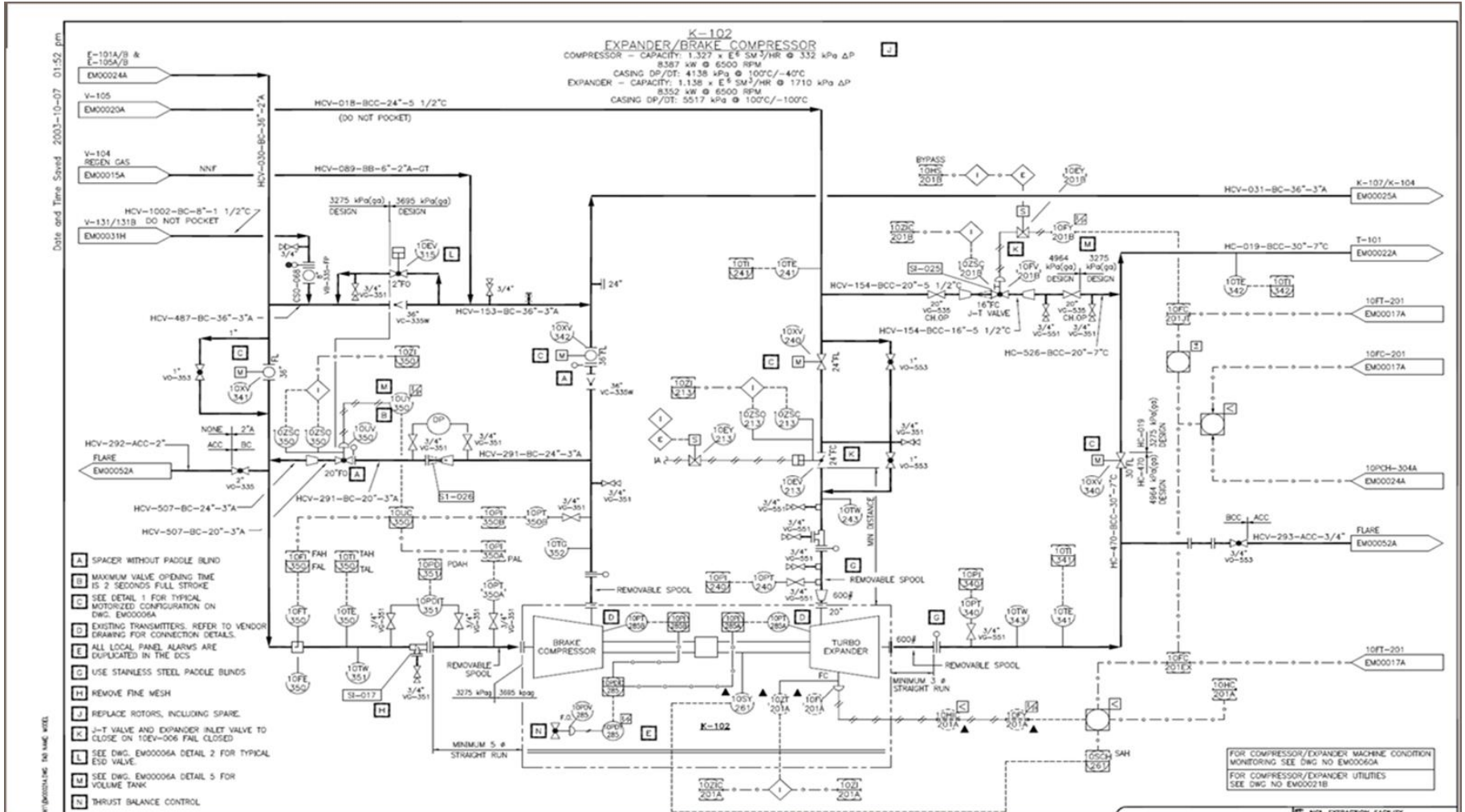
Technical Hierarchy Overview

Functional loc.	NBU-A6010-K-102	Valid From	2017.05.01
Description	CMP, EXPANDER / BRAKE K-102		
1 NBU	NATURAL GAS BUSINESS UNIT		
3 NBU-FSJ	FORT ST JOHN		
3 NBU-GRP	GRANDE PRAIRIE		
3 NBU-EMP	EMPRESS FACILITY		
3 NBU-EMP-PE	PROCESS EQUIPMENT		
4 NBU-A6010-C	EMPRESS COMMON		
4 NBU-A6010-DB	DEBUTANIZER		
4 NBU-A6010-DC	DEEP CUT		
5 NBU-A6010-DC-EL	ELECTRICAL EQUIPMENT		
5 NBU-A6010-DC-ME	MECHANICAL EQUIPMENT		
5 NBU-A6010-DC-RO	ROTATING EQUIPMENT		
5 NBU-A6010-DC-CO	COMPRESSORS		
6 NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102		
6000017	COMPRESSOR, EXPANDER BRAKE	ROTOFLOW	
7 NBU-A6010-K-102-03	CONTROL AND MONITORING		
7 NBU-A6010-K-102-04	LUBRICATION SYSTEM		
7 NBU-A6010-K-102-05	SHAFT SEAL SYSTEM		
8 NBU-A6010-FI-102A	VSL, FILTER FI-102A		
8 NBU-A6010-FI-102B	VSL, FILTER FI-102B		
6 NBU-A6010-M-102	TURBOEXPANDER, BRAKE COMPR M-102		
5 NBU-A6010-K-102-SC	RELATED SAFETY AND CONTROL		
6 NBU-A6010-K-103	CMP, REGENERATION GAS K-103		
6 NBU-A6010-K-104	CMP, RESIDUE GAS K-104		
5 NBU-A6010-K-105	INSTRUMENT AIR COMPRESSORS K-105A/B		
5 NBU-A6010-K-106/K-106B	REFRIGERANT COMPRESSORS K106/K106B		
6 NBU-A6010-K-107	CMP, RESIDUE GAS BOOSTER K-107		
6 NBU-A6010-K-110	CMP, AIR DRIVEN BOOSTER GAS K-110		
5 NBU-A6010-DC-EG	ELECTRIC GENERATORS		
5 NBU-A6010-DC-PU	PUMPS		
5 NBU-A6010-DC-SC	SAFETY AND CONTROL EQUIPMENT		
3 NBU-EMP-NP	NON-PROCESS EQUIPMENT		





Construction of Technical Structure Compressor Technical Drawings





ISO 14224 Boundary Definition

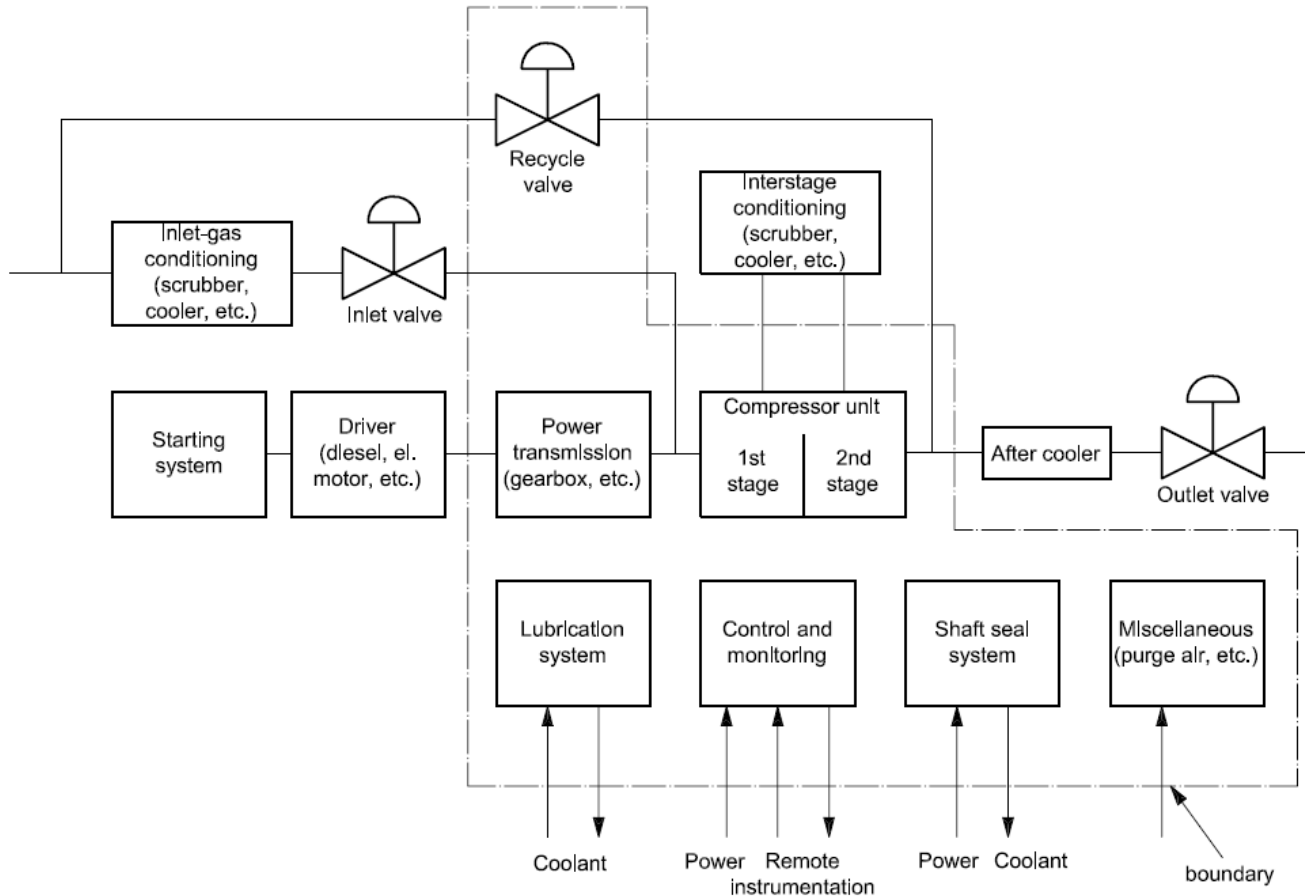


Figure A.2 — Boundary definition — Compressors



ISO 14224 Equipment Subdivision

Table A.9 — Equipment subdivision — Compressors

Equipment class	Compressors					
Subunit	Power transmission	Compressor	Control and monitoring	Lubrication system	Shaft seal system	Miscellaneous
Maintainable item/Part	Gearbox/ variable drive Bearings Coupling to the driver Coupling to the driven unit Lubrication Seals	Casing Rotor with impellers Balance piston Interstage seals Radial bearing Thrust bearing Shaft seals Internal piping Valves Antisurge system ^b Piston Cylinder liner Packing	Actuating device Control unit Cables and junction boxes Internal power supply Monitoring Sensors ^a Valves Wiring Piping Seals	Oil tank with heating system Pump Motor Check valves Coolers Filters Piping Valves Lube oil	Oil tank with heating Reservoir Pump Motor Gear Filters Valves Seal oil Dry gas seal Mechanical seal Scrubber	Base frame Piping, pipe support and bellows Control valves Isolation valves Check valves Coolers Silencers Purge air Magnetic-bearing control system Flange joints
^a Specify type of sensor, e.g. pressure, temperature, level, etc. ^b Including recycle valve and controllers.						



Construction of Technical Hierarchy

Equipment Properties for Compressors (subset)

Table A.10 — Equipment-specific data — Compressors

Name	Description	Unit or code list	Priority
Compressed medium	Gas or air compressor	Gas, air	High
Type of driver	Driver unit (equipment class, type and identification code)	Specify	High
Gas handled	Average molar mass (specific gravity × 28,96)	Grams per mole	Medium
Suction pressure	Design – first stage	Pascal (bar)	Medium
Suction pressure	Operating – first stage	Pascal (bar)	Low
Discharge pressure	Design – last stage	Pascal (bar)	High
Discharge pressure	Operating – last stage	Pascal (bar)	Medium
Flow rate	Design	Metres cubed per hour	High
Flow rate	Operating	Metres cubed per hour	Low
Discharge temperature	Design	Degrees Celsius	Medium
Discharge temperature	Operating	Degrees Celsius	Low
Power	Design power	Kilowatt	High
Utilization	Percent utilization compared to design	Percent	Medium



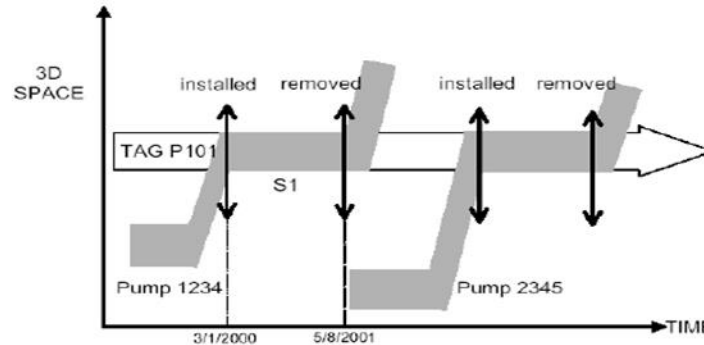
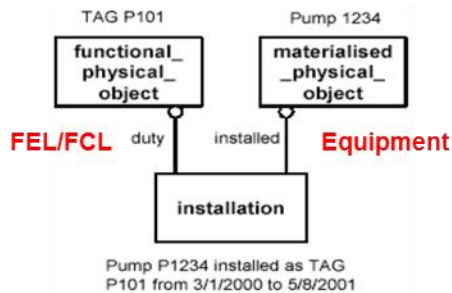
Functional Location / Equipment Relationship

ISO 15926-2, Section E.3.3

Functional equipment location Tag P101 is an intangible object that defines process requirements for a particular pumping service, e.g. pressure, temperature, flow, fluid type (Tag P101 in the example below)

Equipment items (serial numbers 1234 and 2345) define specific materialized objects that execute process requirements

Field equipment change-outs are captured in SAP via corresponding equipment dismantle/installation transactions (on 5/8/2001 S/N 1234 was dismantled and S/N 2345 installed)



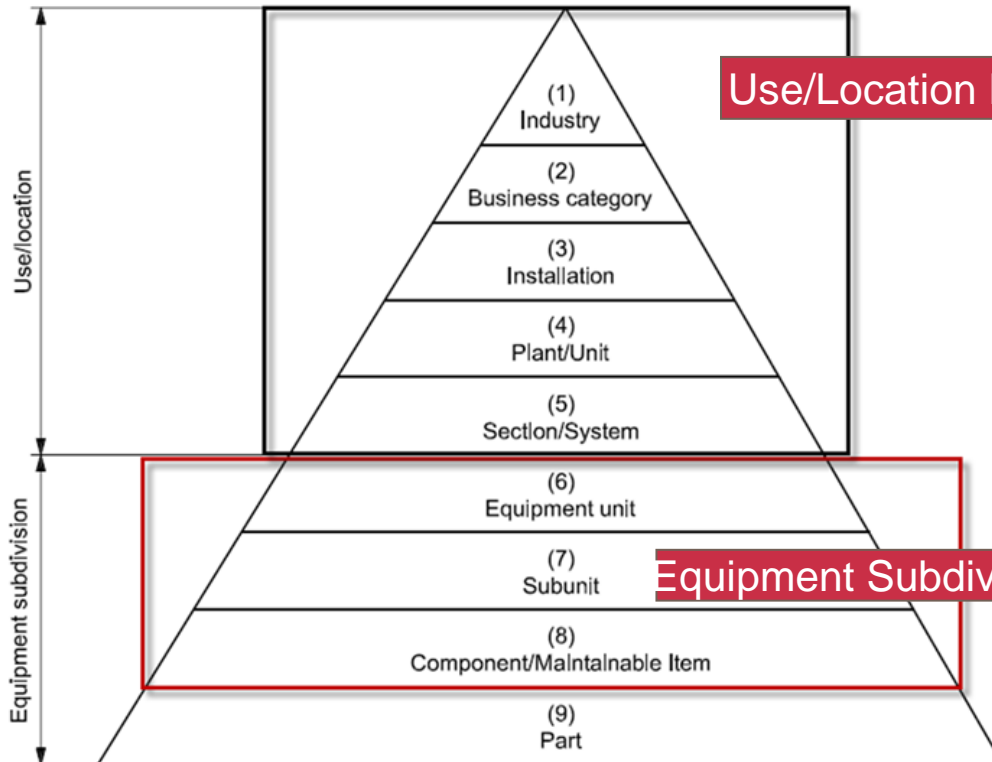
The duty represented by TAG P101, and Pump 1234 are coincident for the period of the installation, i.e. the state S1 of Pump 1234 that is installed as TAG P101 is in fact also a state of TAG P101. TAG P101 consists of those states of the pumps that are installed in this location.

ISO 15926-2 (Data Model) Industrial automation systems and integration—Integration of life-cycle data for process plants including oil and gas production facilities, Figures E.9 and E.10.



ISO 14224 Technical Structure

- ERP is system of record for all technical tags
- One unique ID for each tag throughout all systems, records, and in the field
- Equipment interrelationships defined in system



Change Functional Location: Classification

Object: NBU-A6010-K-102
 Description: CMP, EXPANDER / BRAKE K-102
 Class Type: 003 Functional Location

Assignments:

Class	Description
PE_RO_CO_CE	Compressors, centrifugal

Values for Class PE_RO_CO_CE - Object NBU-A6010-K-102

Use/Loc	Concident	Reference
Industry	Natural Gas	
Business category	Upstream	
Installation category	Gas processing	
Plant/Unit category	Onshore production plant	
Section/System	EP Gas process/treatment	
Operation category	Manned	
Number of redundant un...		
Normal operating mode		
Ambient conditions		
Utilization of rated capac...		

Installation Category Value Hierarchy:

Value	Description
01	No Entry
01.01	Upstream (EAP)
01.02	Drilling rig
01.03	Gas processing
01.04	Intervention vessel
01.05	Oil/gas prod facility (on/off)
01.06	Upstream pipeline
02	Upstream terminal
02.01	Midstream
02.02	Combined heating + power (CHP)
02.03	Gas to liquids (GTL) plant
02.04	LNG plant
02.05	LPG plant
02.06	Midstream pipeline
02.07	Midstream terminal
02.08	Shipping (LNG, OI)
02.09	Storage
03	Downstream
03.01	Downstream gas processing
03.02	Downstream pipeline
03.03	Downstream shipping
03.04	Downstream terminal
03.05	Refinery
04	Petrochemical
04.01	Petrochemical complex
04.02	Petrochemical shipping
04.03	Petrochemical terminal

Functional Location Structure: Structure List

Primary/Parent equipment (green high-light)

Valid From: Compressor unit boundary. 93 technical tags in total

Functional loc.	Description
NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102
6 NBU-A6010-K-102	CONTROL AND MONITORING
7 NBU-A6010-K-102-03	LUBRICATION SYSTEM
7 NBU-A6010-K-102-04	ELEM, FILM ORIFICE, E-109/110 EXC COOLER
8 NBU-A6010-10FO-267	GAUGE, PRS DIFF, F-101A/B, K-102 EXP CMP
8 NBU-A6010-10FDG-278	GAUGE, PRS DIFF, F-101A/B, K-102 EXP CMP
8 NBU-A6010-10PDG-279	XCHGR, COOLER E-109
8 NBU-A6010-E-109	XCHGR, COOLER E-110
8 NBU-A6010-E-110	VSL, FILTER FI-101A
8 NBU-A6010-FI-101A	VSL, FILTER FI-101B
8 NBU-A6010-FI-101B	PMP, LUBE OIL DRAIN P-106
8 NBU-A6010-P-106	PMP, LUBE OIL DRAIN P-107
8 NBU-A6010-P-107	PMP, LUBE OIL FILLER P-108
8 NBU-A6010-P-108	INX, OIL RESERVOIR S-111
8 NBU-A6010-S-111	INX, OIL STORAGE S-113
8 NBU-A6010-S-113	INX, OIL STORAGE S-114
8 NBU-A6010-S-114	INX, OIL STORAGE S-115
8 NBU-A6010-S-115	SHAFT SEAL SYSTEM
7 NBU-A6010-K-102-05	VSL, FILTER FI-102A
8 NBU-A6010-FI-102A	VSL, FILTER FI-102B
8 NBU-A6010-FI-102B	TURBOEXPANDER, BRAKE CONDR K-102
6 NBU-A6010-K-102	RELATED SAFETY AND CONTROL
5 NBU-A6010-K-102-SC	

Interrelated equipment (yellow high-light)



K-102 Boundary Definition

Functional loc.	NBU-A6010-K-102	Valid From	2016.06.07
Description	CMP, EXPANDER / BRAKE K-102		
5 NBU-A6010-DC-CO	COMPRESSORS		
6 NBU-A6010-K-102	CMP, EXPANDER / BRAKE K-102		
6000017	COMPRESSOR, EXPANDER BRAKE	ATLAS COPCO	
7 NBU-A6010-K-102-03	CONTROL AND MONITORING		
7 NBU-A6010-K-102-04	LUBRICATION SYSTEM		
8 NBU-A6010-10FO-267	ELEM, FLW ORIFICE, E-109/110 EXC COOLER		
8 NBU-A6010-10PDG-278	GAUGE, PRS DIFF, F-101A/B, K-102 EXP CMP		
8 NBU-A6010-10PDG-279	GAUGE, PRS DIFF, F-101A/B, K-102 EXP CMP		
8 NBU-A6010-E-109	XCHGR, COOLER E-109		
8 NBU-A6010-E-110	XCHGR, COOLER E-110		
8 NBU-A6010-FI-101A	VSL, FILTER FI-101A		
8 NBU-A6010-FI-101B	VSL, FILTER FI-101B		
8 NBU-A6010-P-106	PMP, LUBE OIL DRAIN P-106		
8 NBU-A6010-P-107	PMP, LUBE OIL DRAIN P-107		
8 NBU-A6010-P-108	PMP, LUBE OIL FILLER P-108		
8 NBU-A6010-S-111	TNK, OIL RESERVOIR S-111		
8 NBU-A6010-S-113	TNK, OIL STORAGE S-113		
8 NBU-A6010-S-114	TNK, OIL STORAGE S-114		
8 NBU-A6010-S-115	TNK, OIL STORAGE S-115		
7 NBU-A6010-K-102-05	SHAFT SEAL SYSTEM		
6 NBU-A6010-M-102	TURBOEXPANDER, BRAKE COMPR M-102		
5 NBU-A6010-K-102-SC	RELATED SAFETY AND CONTROL		
6 NBU-A6010-10EV-315	VLV, ESD, BYP, K-102 BRAKE CMP		
6 NBU-A6010-10XV-341	VLV, MOV, SWT ON/OFF, K-102 BRAKE CMP		
6 NBU-A6010-10XV-342	VLV, MOV, SWT ON/OFF, K-102 BRAKE CMP		
5 NBU-A6010-K-102-FG	FIRE AND GAS DETECTION		
6 NBU-A6010-K-103	CMP, REGENERATION GAS K-103		
6 NBU-A6010-K-104	CMP, RESIDUE GAS K-104		
5 NBU-A6010-K-105	INSTRUMENT AIR COMPRESSORS K-105A/B		
5 NBU-A6010-K-106/K-106B	REFRIGERANT COMPRESSORS K106/K106B		
6 NBU-A6010-K-107	CMP, RESIDUE GAS BOOSTER K-107		
6 NBU-A6010-K-110	CMP, AIR DRIVEN BOOSTER GAS K-110		

K-102 Boundary Envelope

K-102 Dedicated Equipment



Use/Location Data

Display Functional Location: Classification

Object

Functional loc. NBU-A6010-K-102
Description CMP, EXPANDER / BRAKE K-102
Class Type 003 Functional Location

Assignments

Class	Description
PE_RO_CO_CE	Compressors, centrifugal

Entry 1

Values for Class PE_RO_CO_CE - Object NBU-A6010-K-102

Characteristic Description	Value
Industry	Natural Gas
Business category	Upstream
Installation category	Gas processing
Plant/Unit category	Onshore production plant
Section/System	EP Gas process/treatment
Operation category	Manned
Number of redundant un...	
Normal operating mode	
Ambient conditions	
Utilization of rated capaci...	

Installation category

Value Hierarchy for Char. Installation category	Description	Text
Installation category		
01	No Entry	
01.01	Upstream (E&P)	
01.02	Drilling rig	
01.03	Gas processing	
01.04	Intervention vessel	
01.05	Oil/gas prod facility (on/off	
01.06	Upstream pipeline	
01.06	Upstream terminal	
02	Midstream	
02.01	Combined heating + power (CHP)	
02.02	Gas to liquids (GTL) plant	
02.03	LNG plant	
02.04	LPG plant	
02.05	Midstream pipeline	
02.06	Midstream terminal	
02.07	Shipping (LNG, Oil)	
02.08	Storage	
03	Downstream	
03.01	Downstream gas processing	
03.02	Downstream pipeline	
03.03	Downstream shipping	
03.04	Downstream terminal	
03.05	Refinery	
04	Petrochemical	
04.01	Petrochemical complex	
04.02	Petrochemical shipping	
04.03	Petrochemical terminal	



Malfunction Reporting

Impart Data Quality on Inception

Step	Details	Responsibility
Work Initiation	Problem Report (equipment-level failure notations), system QA checks	Facility personnel
Approvals and processing	Work approval, planning and scheduling, create statistical records	Operations Superintendent
Execution, repair notes, and close-out	Repair Report (item-level failure notations), system QA checks	Maintenance Lead Technician
Failure data quality control	QA/QC, consequence assessment, and methods feedback	Reliability Engineer



Malfunction Problem Report (Work Initiation)

Equipment-Level Notations

ISO 14224:2006(E)

9.5 Failure data

A uniform definition of failure and a method of classifying failures are essential when it is necessary to combine data from different sources (plants and operators) in a common RM database.

A common report, as given in Table 6 (see also Table 3), for all equipment classes shall be used for reporting failure data. For some equipment classes, e.g. subsea equipment, minor adaptations can be necessary.

The minimum data needed to meet the objectives of this International Standard are identified by (*). However, the addition of certain other data categories can significantly improve the potential usability of the RM data; see Annex D.

Table 6 — Failure data

Category	Data to be recorded	Description
Identification	Failure record (*)	Unique failure record identification
	Equipment identification/Location (*)	E.g. tag number (see Table 5)
	Failure date (*)	Date of failure detection (year/month/day)
Failure data	Failure mode (*)	Usually at equipment-unit level (level 6) (see B.2.6) ^a
	Failure impact on plant safety (e.g. personnel, environment, assets) ^b	Usually zero, partial or total
	Failure impact on plant operations (e.g. production, drilling, intervention) ^b	Usually zero, partial or total
	Failure impact on equipment function (*)	Effect on equipment-unit function (level 6): critical, degraded, or incipient failure ^c
	Failure mechanism	The physical, chemical or other processes which have led to a failure (see Table B.2)
	Failure cause ^d	The circumstances during design, manufacture or use which have led to a failure (see Table B.3)
	Subunit failed	Name of subunit that failed (see examples in Annex A)
	Component/Maintainable item(s) failed	Name of the failed maintainable item(s) (see Annex A)
	Detection method	How the failure was detected (see Table B.4)
	Operating condition at failure	Running, start-up, testing, idle, standby
Remarks	Additional information	Give more details, if available, on the circumstances leading to the failure: failure of redundant units, failure cause(s) etc.

^a For some equipment categories such as subsea equipment, it is recommended to also record failure modes on taxonomic levels lower than the equipment-unit level.
^b See example of failure consequence classification in Table B.2.
^c For some equipment categories and applications it may be sufficient to record critical and non-critical (degraded + incipient) failures only.
^d The failure cause and sometimes the failure mechanism are not known when the data are collected, as they commonly require a root cause analysis to be performed. Such analysis shall be performed for failures of high consequence, high repair/down time cost, or failures occurring significantly more frequent than what is considered "normal" for this equipment unit class ("worst actors").
 (*) indicates the minimum data that shall be collected.

The screenshot displays the SAP PM Notification: Malfunction Report interface. Key elements include:

- Notification Header:** Shows notification number 80000000001 Z2, status OSNO, and partner AFRQ.
- Reference Object:** Functional location NBU-A6010-K-102, Equipment 6000017, and Assembly COMPRESSOR, EXPANDER BRAKE.
- Failure Mode Selection:** A tree view under 'Failure Mode' shows 'Failure Mode Failure Mode' expanded to 'C0000100 Compressors -'. A red box highlights 'Failure Mode' in the Subject field.
- System Checks:** A red box on the right lists system checks that must be satisfied before saving the notification, such as 'Condition before malfunction is required' and 'Effect on system operation is required'.
- Equipment Class-Specific Failure Modes:** A red box points to the 'C0000100 Compressors -' category in the failure mode list.
- Failure Mode Details:** A red box points to the 'Failure Mode (ISO 14224)' section in the coding window.
- Methodology-Specific Glossary Text:** A red box points to the 'ISO 14224 Methodology' section in the coding window.
- Performance Assistant:** A window at the bottom provides detailed information about the selected failure mode, including its definition, use, and SAP functionality.



Malfunction Repair Report (Work Close-out) Component-Level Notations

Change PM Notification: Malfunction Report

Notification: 100000035 Z2 AGA4 TT Suction temperature failed
Notific. Status: ATCO NOPR NOPT ORAS APPR
Order: 200000165

Problem Report | Repair Report | Tasks | Activities | Planning | Documents

Maintainable Items | Root cause | Tasks | Activities

No.	Code gr...	Ma...	Maint. Items	Code gr...	Fail...	Failure Mech	Text	It...	Assembly	AssemblyDescriptn
1	CO000300	0700	Control and monitoring - Sensors	FM000300	3.0	Instrument failure -	Gene...replace RTD			

System checks on notification completion

- Malfunction end date is required.
- Failure mechanism is required.
- Maintainable Item is required.
- Corrective maintenance activity is required.
- Root cause is required.

Equipment subdivision

- Maint. Items Maintainable Items
 - CO000100 Power transmission -
 - CO000200 Compressor -
 - CO000300 Control and monitoring -
 - 0001 No detail
 - 0100 Actuating device
 - 0200 Control unit
 - 0300 Cables and junction boxes
 - 0400 Valves
 - 0500 Internal power supply
 - 0600 Monitoring
 - 0700 **Sensors**
 - 0800 Valves
 - 0900 Wiring
 - 1000 Piping
 - 1100 Seals
 - CO000400 Lubrication system -
 - CO000500 Shaft seal system -
 - CO009900 Miscellaneous -

Failure Mechanism

- Failure Mech Failure Mechanism
 - FM000100 Mechanical failure -
 - FM000200 Material failure -
 - FM000300 Instrument failure -
 - 3.0 General
 - 3.1 Control failure
 - 3.2 No signal/indication/alarm
 - 3.3 Faulty signal/indication/alarm
 - 3.4 Out of adjustment
 - 3.5 Software failure
 - 3.6 Common cause/mode failure
 - FM000400 Electrical failure -
 - FM000500 External influence -
 - FM000600 Miscellaneous -

Display Long Text

```
INSTRUMENT FAILURE
---
3.0 GENERAL: failure related to instrumentation, but no d
known.
3.1 CONTROL FAILURE: no, or faulty, regulation
3.2 NO SIGNAL/INDICATION/ALARM: no signal/indication/alar
expected.
3.3 FAULTY SIGNAL/INDICATION/ALARM: signal/indication/ala
wrong in relation to actual process. could be spurious,
intermittent, oscillating, arbitrary
3.4 OUT OF ADJUSTMENT: calibration error, parameter drift
3.5 SOFTWARE FAILURE: faulty or no control/monitoring/ope
due to software failure.
3.6 COMMON CAUSE/MODE FAILURE: several instrument items f
simultaneously, e.g. redundant fire and gas detectors. al
```



Event Consequence Assessment

Change PM Notification: Classification

Object

Notification: 10000560 Item number: 1 Outer race bent

Class Type: 015 Message Item

Values for Class PE_ME_WI - Object 10000560 0001

General

Characteristic Description	Value
Consequences of failure	Consequences of failure
Equipment/Area affected	
Facility downtime	

Value Hierarchy for Char. Consequences of failure

Value Hierarchy for Char. Consequences of failure	Desc.	Text
Consequences of failure		
E	Environment	
O	Operations	
O1	Operations catastrophic	
O2	Operations severe	
O3	Operations moderate	
O4	Operations minimal	
041	Maintenance cost < US\$50,000	
O5	Operations negligible	
P	Production	
P1	Production catastrophic	
P2	Production severe	
P3	Production moderate	
P31	Production loss < US\$250K	
P4	Production minimal	
P5	Production negligible	
S	Safety	

Table C.1.png - Windows Photo Viewer

ISO 14224:2006(E)

Table C.1 — Failure-consequence classification

Consequences	Category			
	Catastrophic Failure that results in death or system loss	Severe Severe injury, illness or major system damage (e.g. < USD 1 000 000)	Moderate Minor injury, illness or system damage (e.g. < USD 250 000)	Minor Less than minor injury, illness or system damage (e.g. < USD 50 000)
Safety	I — Loss of lives — Vital safety-critical systems inoperable	V — Serious personnel injury — Potential for loss of safety functions	IX — Injuries requiring medical treatment — Limited effect on safety functions	XIII — Injuries not requiring medical treatment — Minor effect on safety function
Environmental	II Major pollution	VI Significant pollution	X Some pollution	XIV No, or negligible, pollution
Production	III Extensive stop in production/operation	VII Production stop above acceptable limit *	XI Production stop below acceptable limit *	XV Production stop minor
Operational	IV Very high maintenance cost	VIII Maintenance cost above normal acceptable *	XII Maintenance cost at or below normal acceptable *	XVI Low maintenance cost

* It is necessary to define acceptable limits for each application.



Preventive Maintenance and Inspections

Program

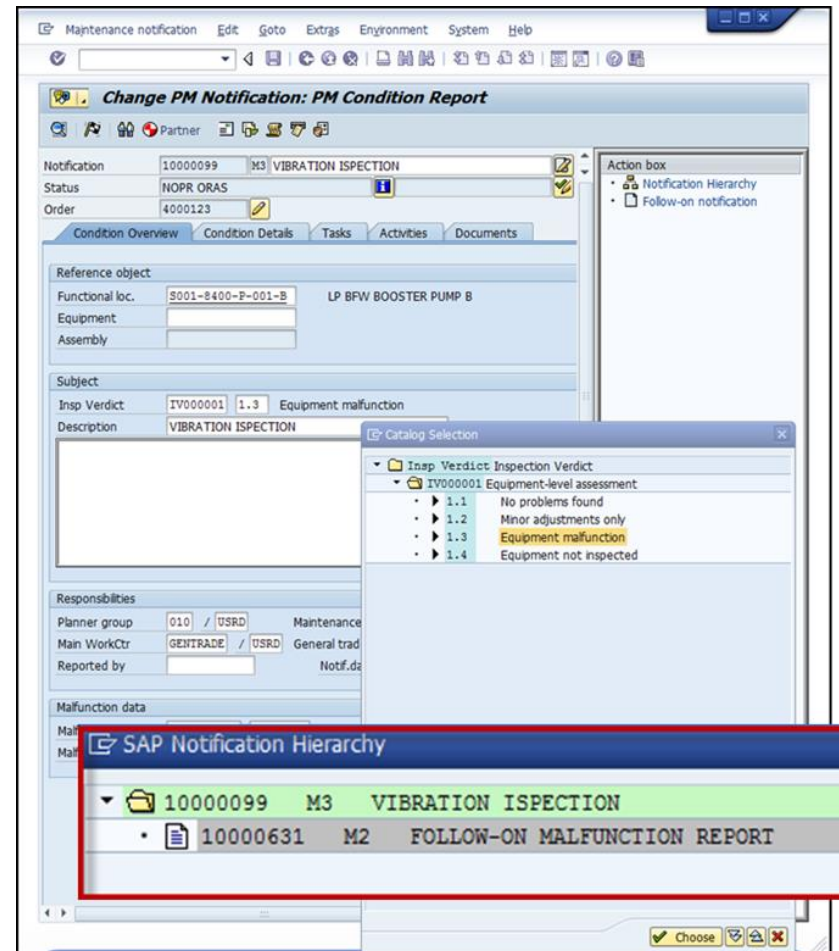
- Administered as administrative or technical tag level
- Results reported at technical tag level

PM Condition Report

- One condition report per technical tag inspected
- Inspection verdict and condition details
- Generated from object list of PM inspection order

Follow-on malfunction report

- Generated for any equipment malfunction verdict
- Linked to PM Condition Report as subordinate object





Quality Control Processes

Review malfunction and condition reports to ensure completeness and a clear and concise description of what happened

Identify “non-malfunction” malfunction reports and set user status to exclude them from the failure data dataset

Review other ERP data to identify missing failure events, e.g. review materials booked against blanket orders of cost centers, review preventive maintenance and inspection results to ensure follow-on malfunction reporting was done, etc.

Identify and document follow-on requirements, e.g. preventive maintenance additions, facilities change requirements, SJP requirements

Circle-back with personnel when issues are found with completion of malfunction reports



ISO 14224:2006

Petroleum, petrochemical and natural gas industries -- Collection and exchange of reliability and maintenance data for equipment

ISO 15926-2:2003

Industrial automation systems and integration -- Integration of life-cycle data for process plants including oil and gas production facilities -- Part 2: Data model

OREDA

Offshore Reliability Database, Joint Industry Project that developed ISO 14224



Thank you

**Reliability
Dynamics**

Tony Ciliberti

Principal Engineer | Reliability Dynamics | LinkedIn: [tciliberti](#)

tony.ciliberti@rd-eam.com



Company overview

- Registered engineering company specializing in equipment reliability and maintenance solutions for corporate software systems
- Primary product is the Industry Standard Solution for Plant Maintenance (ISPM®)

Current and recent customers

- Brunei Methanol Company
- Precision Drilling
- Pembina Pipeline
- QGOG (Maximo)
- Maersk Drilling
- Nexen Inc
- Marathon Oil
- Fortis Alberta