SAP-CENTRIC EAM 2006

Driving Value from SAP-Centric EAM

Use SAP PM to Capture Quality Equipment Reliability Data

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eventure

Agenda and ISO References

- Presentation
  - Technical concepts – Tony
  - Process changes and SAP configuration - Dan
- Key learning topics/take-aways
  - Fundamentals of ISO 14224
  - How to capture ISO 14224 with SAP PM
  - BP for SAP PM technical objects and technical object structures
- ISO standards referenced
  - ISO 14224, *Petroleum and natural gas industries — Collection and exchange of reliability and maintenance data for equipment*
  - ISO 15926, *Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities.*

Nexen and SAP

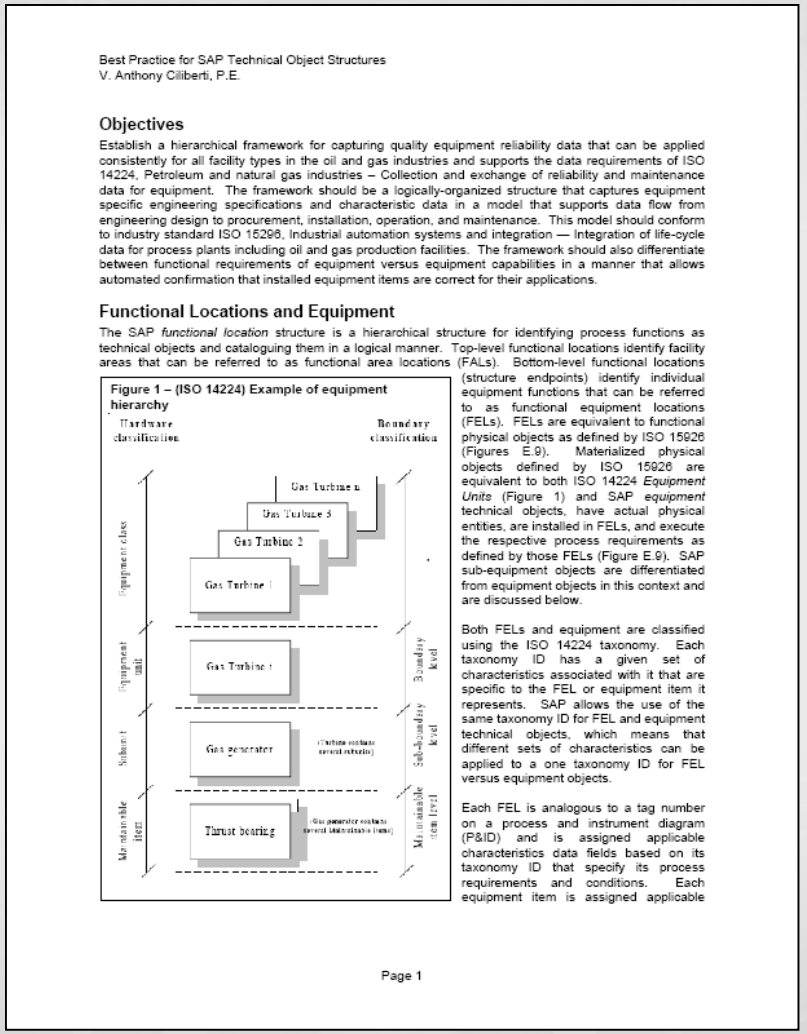
- Nexen, Inc
  - Global oil and gas company with 3000+ employees and annual revenues of US$2.9 billion
- SAP
  - First go-live in January 2002 (version 4.6C)
  - Global implementation with shared system configuration and design
  - PM system has
    - Common order and notification types
    - Unique technical object structures and classifications

Changes at Nexen

- Reasons for change
  - Incomplete and disparate equipment characteristic, reliability, and cost data
  - Data mining required for maintenance analyses
- Key changes
  - 1.Standardize technical object structures
  - 2.Capture detailed equipment characteristic and reliability data with taxonomy
  - 3.Modify work processes to facilitate complete, efficient, and accurate data capture

Change 1: Standardize Technical Object Structures

- Define rules for technical object configuration and classification.
  - Functional area location (FAL) versus functional equipment location (FEL)
  - Functional physical object vs. materialized physical object
  - FEL vs. primary equipment vs. sub-equipment
- Explicitly define ISO 14224 equipment unit boundaries with technical objects



Best Practice for SAP Technical Object Structures
V. Anthony Ciliberti, P.E.

Objectives

Establish a hierarchical framework for capturing quality equipment reliability data that can be applied consistently for all facility types in the oil and gas industries and supports the data requirements of ISO 14224, Petroleum and natural gas industries – Collection and exchange of reliability and maintenance data for equipment. The framework should be a logically-organized structure that captures equipment specific engineering specifications and characteristic data in a model that supports data flow from engineering design to procurement, installation, operation, and maintenance. This model should conform to industry standard ISO 15926, Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities. The framework should also differentiate between functional requirements of equipment versus equipment capabilities in a manner that allows automated confirmation that installed equipment items are correct for their applications.

Functional Locations and Equipment

The SAP *functional location* structure is a hierarchical structure for identifying process functions as technical objects and cataloguing them in a logical manner. Top-level functional locations identify facility areas that can be referred to as functional area locations (FALs). Bottom-level functional locations (structure endpoints) identify individual equipment functions that can be referred to as functional equipment locations (FELs). FELs are equivalent to functional physical objects as defined by ISO 15926 (Figures E.9). Materialized physical objects defined by ISO 15926 are equivalent to both ISO 14224 *Equipment Units* (Figure 1) and SAP *equipment* technical objects, have actual physical entities, are installed in FELs, and execute the respective process requirements as defined by those FELs (Figure E.9). SAP sub-equipment objects are differentiated from equipment objects in this context and are discussed below.

Figure 1 – (ISO 14224) Example of equipment hierarchy

Both FELs and equipment are classified using the ISO 14224 taxonomy. Each taxonomy ID has a given set of characteristics associated with it that are specific to the FEL or equipment item it represents. SAP allows the use of the same taxonomy ID for FEL and equipment technical objects, which means that different sets of characteristics can be applied to a one taxonomy ID for FEL versus equipment objects.

Each FEL is analogous to a tag number on a process and instrument diagram (P&ID) and is assigned applicable characteristics data fields based on its taxonomy ID that specify its process requirements and conditions. Each equipment item is assigned applicable

Page 1

SAP Functional Location Hierarchy

Purpose/Objectives

- Represent an enterprise's locations and functions completely, logically, and consistently
- Catalog technical objects
- Flexible structure to accommodate both simple and complex facilities
- Facilitate data capture per ISO 14224 and data exchange per ISO 15926

SAP Functional Location Structure: Hierarchical Asset Catalog

Functional Location Template (XXX-XXX-XXX-XXX-XXX-XXX-XXX-XXX-XXX)					
M/O[1]	**Class**[2]	**Node**	**Example**[3]	**Node Type**	
M	BU	Business Unit Entity	YEM	Business and process area	FAL
M	FC	Facility	CPF		
O	P1	Plant Level 1	CPP		
O	P2	Plant Level 2	CP1		
O	P3	Plant Level 3	YPG		
O	P4	Plant Level 4	DG1		
O	EC	Equipment Class	PMP	ISO 14224	
O	ET	Equipment Type		Equipment characteristic	
O	EA	Equipment Application		Process characteristic	
M	EU	Equipment Unit	001	ISO 14224	FEL

1.M/O – Mandatory/Optional for equipment installation (nine levels maximum)
2.Additional plant levels are permissible
3.Abbreviations should be standardized

Functional versus Materialized Object

ISO 15926-2:2003(E)

FEL

SAP Primary Equipment

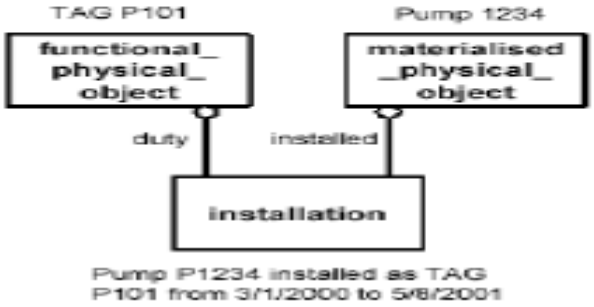


Figure E.9 — Coincident individuals

Figure E.10 shows this example using a space-time map. Here it is possible to see that 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. Indeed, the TAG P101 consists of those states of the pumps that are installed in this place.

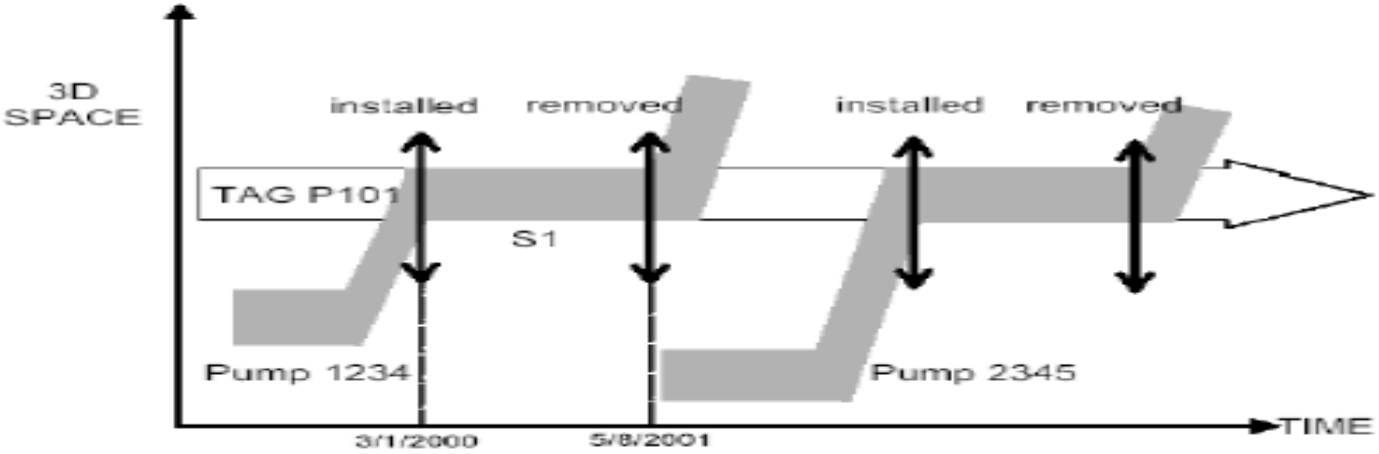
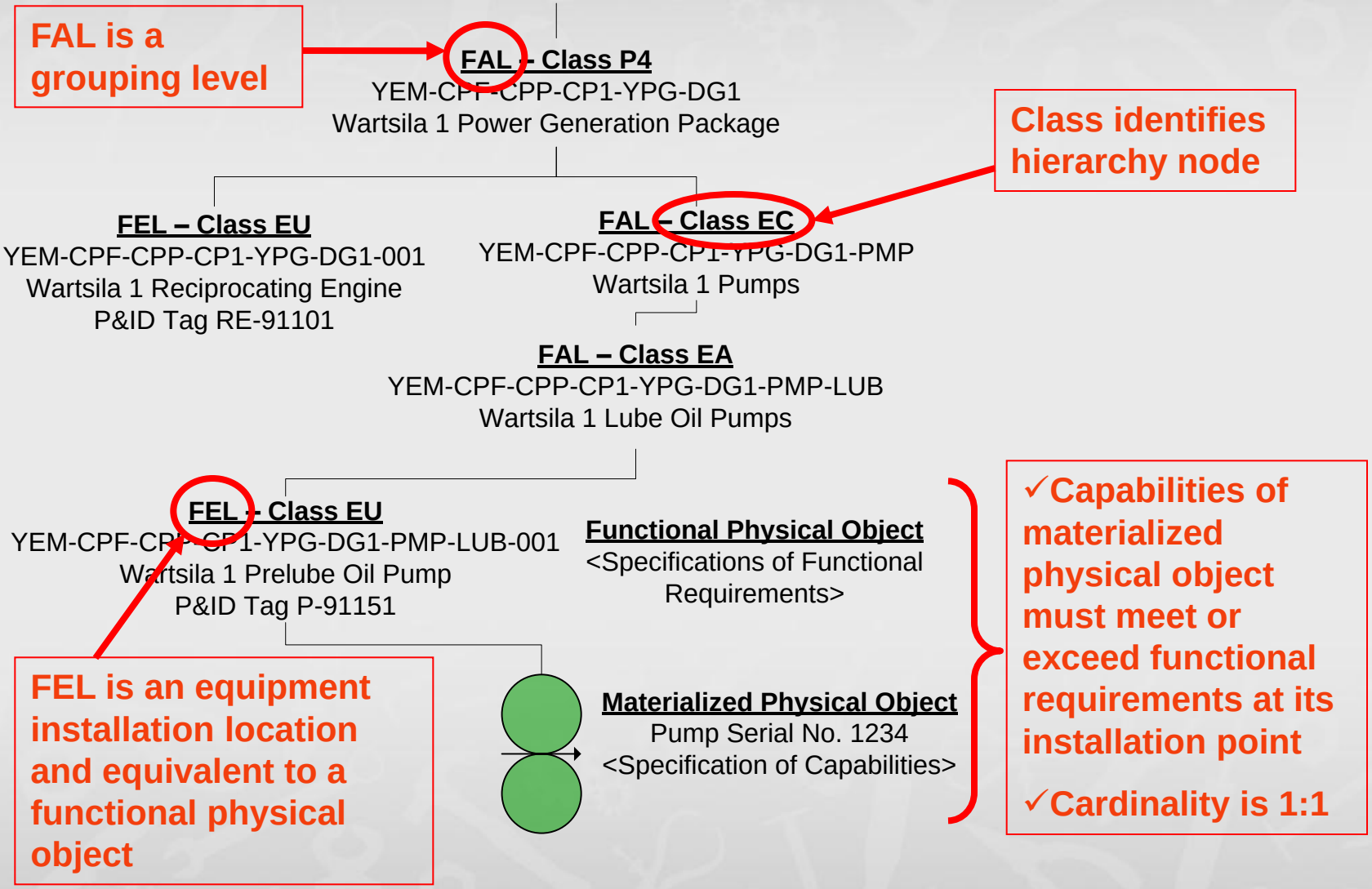


Figure E.10 — Space-time map for coincident individuals.

FAL vs. FEL vs. Primary Equipment



ISO 14224 Equipment Hierarchy

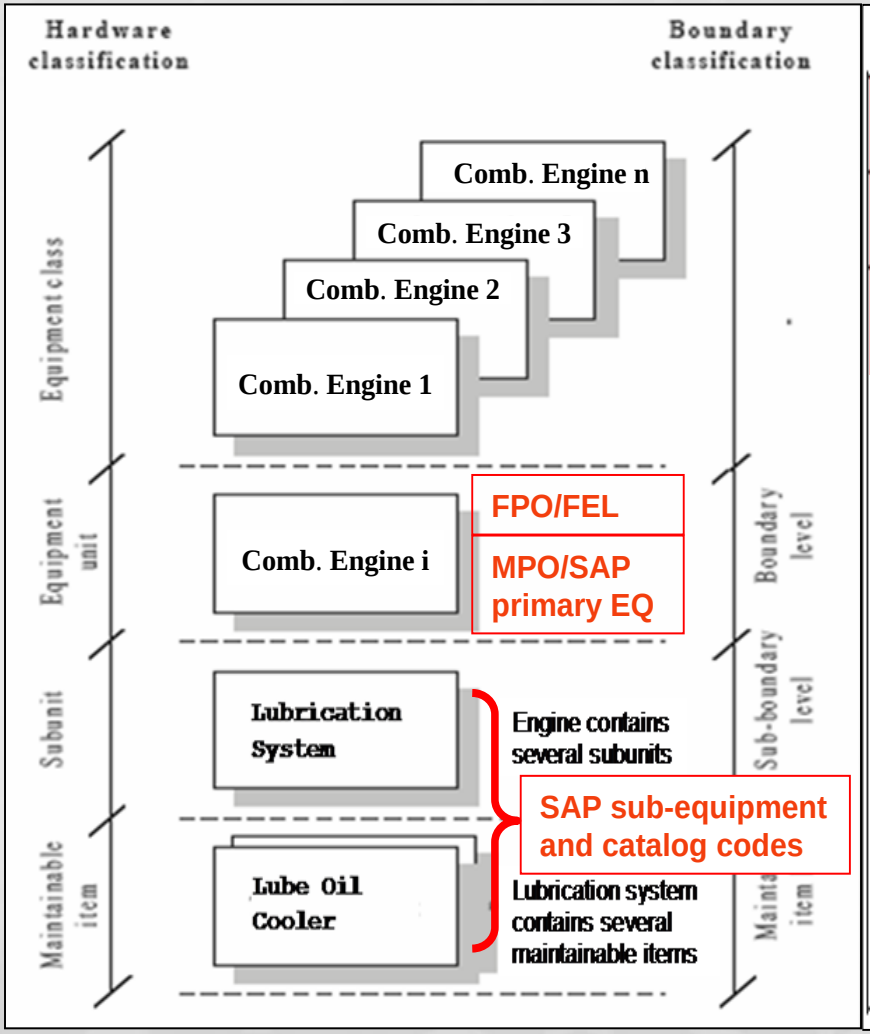
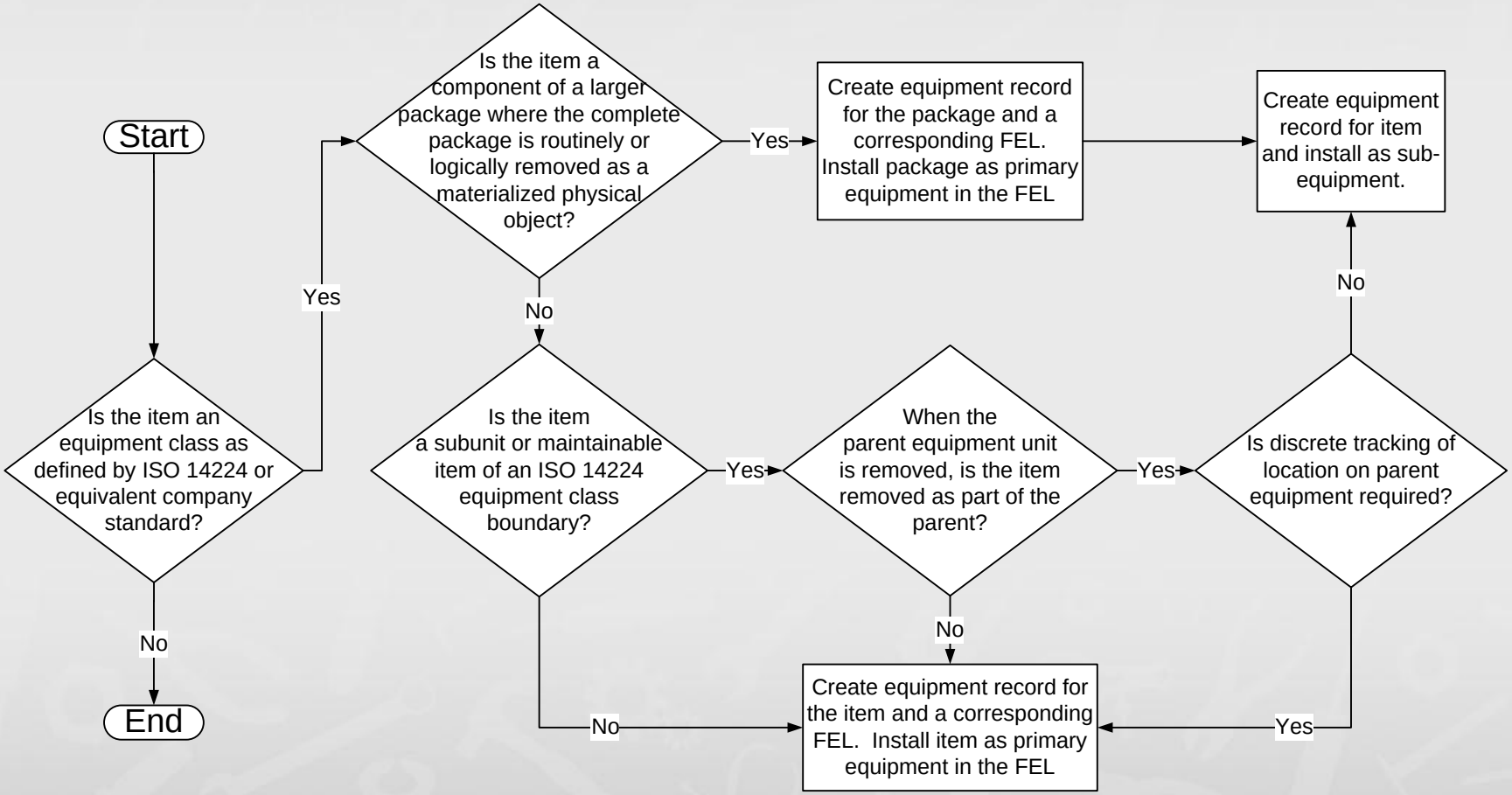


Table A.2 – Equipment unit subdivision – Combustion engines

Equipment unit	Combustion engines					
Subunit	Start system	Combustion engine unit	Control and monitoring	Lubrication system	Cooling system	Miscel-laneous
Maintainable items	Start energy (battery, air) Starting unit Start control	Air inlet Turbocharger Fuel pumps Injectors Fuel filters Exhaust Cylinders Pistons Shaft Thrust bearing Radial bearing Seals Piping Valves	Control Actuating device Monitoring Valves Internal power supply	Reservoir Pump w/motor Filter Cooler Valves Piping Oil Temperature control	Heat exchanger Fan and motor Filter Valves Piping Pump Temperature control	Hood Others Flange joints

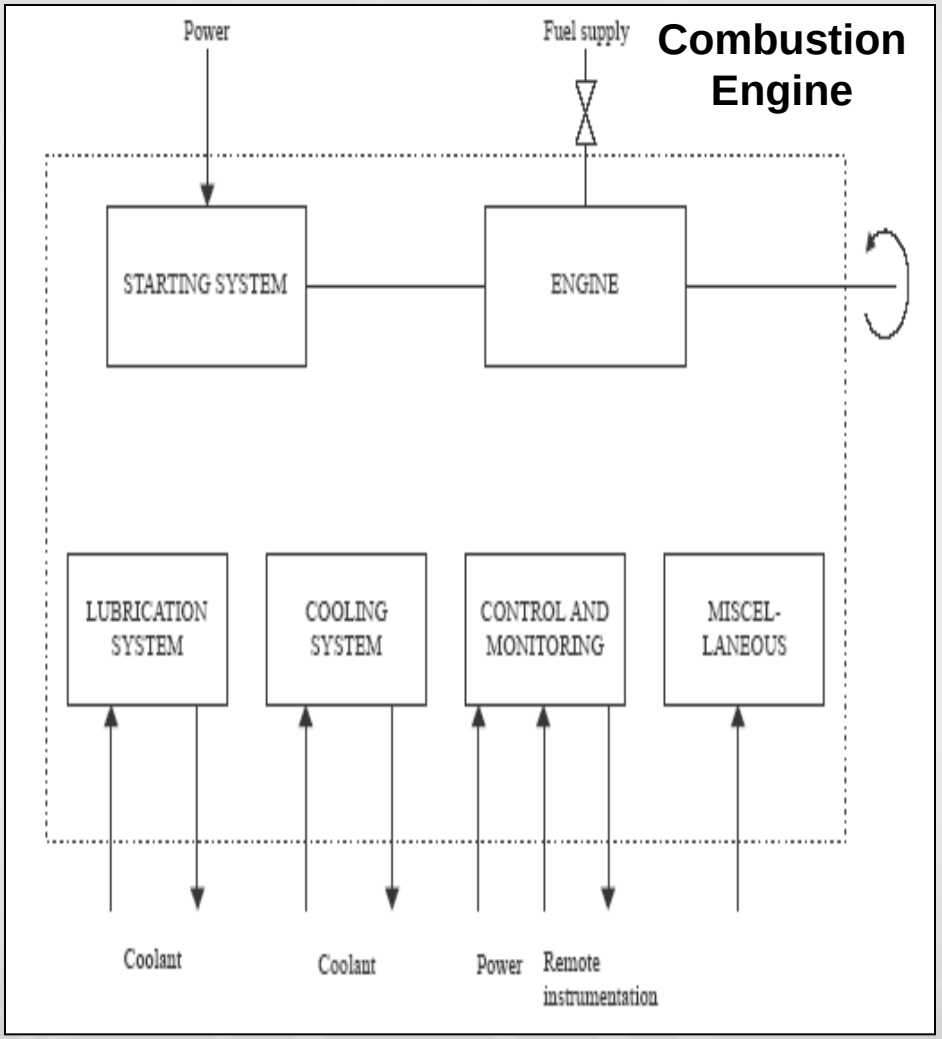
Some maintainable items are ISO equipment class

Decision Logic for FEL, Primary Equipment, and Sub-equipment Objects

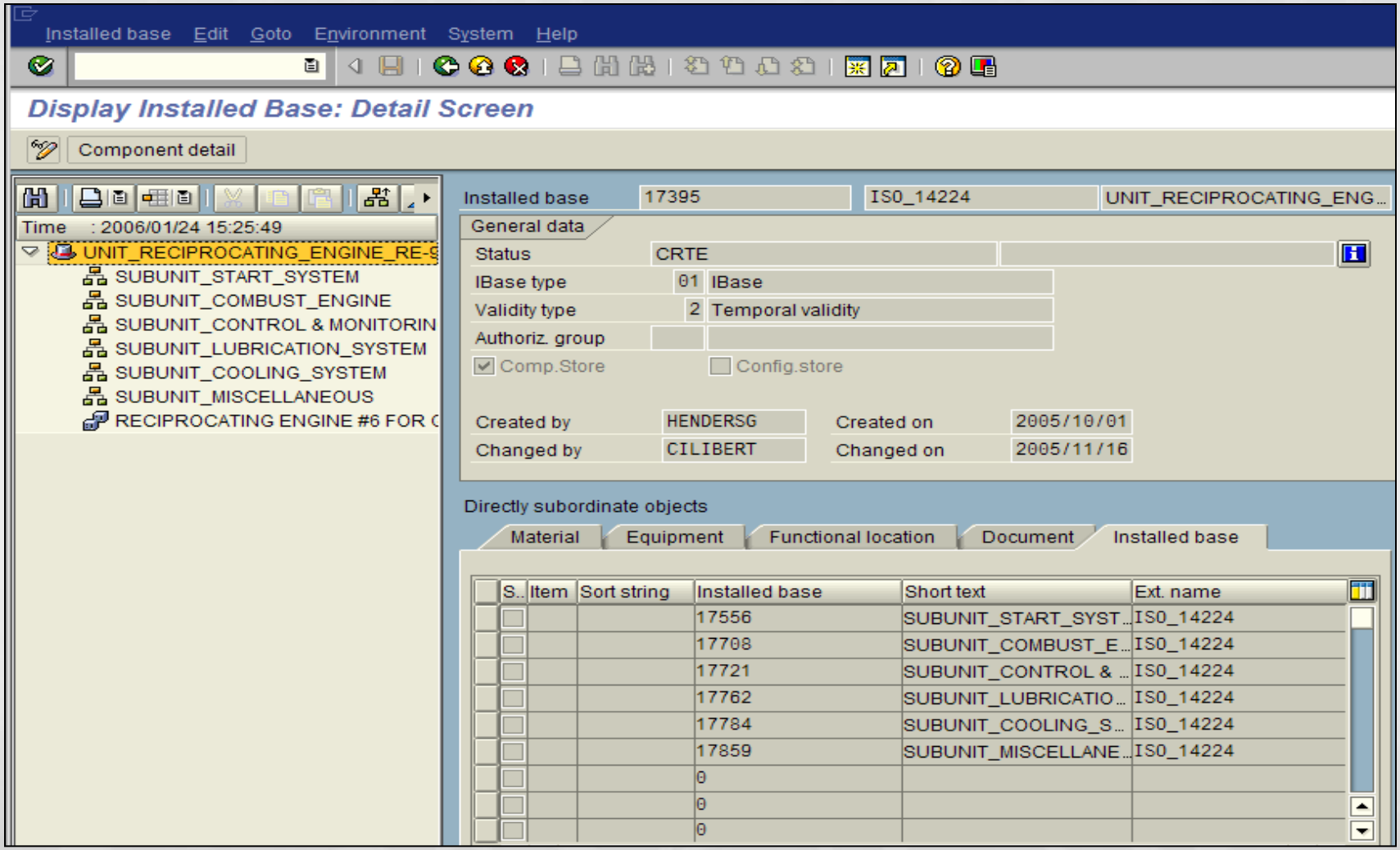


ISO 14224 Equipment Class Boundary Definition

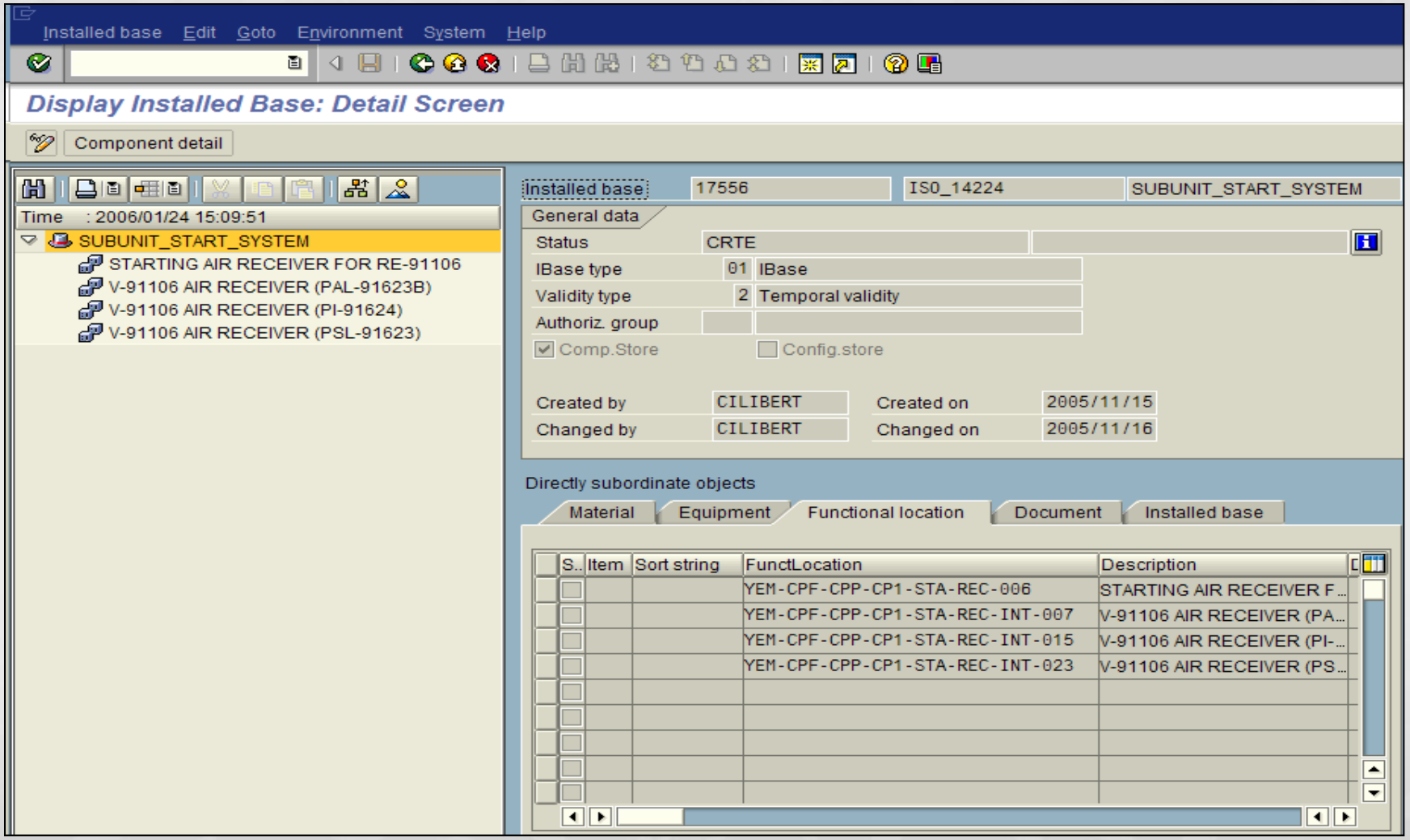
- Boundary used for data analysis
- Establishes consistency in definition of equipment units
  - Shows what is “inside the box.”
  - Includes subunits and maintainable items
- SAP technical objects within the boundary need to be identified
  - Use Installed Base



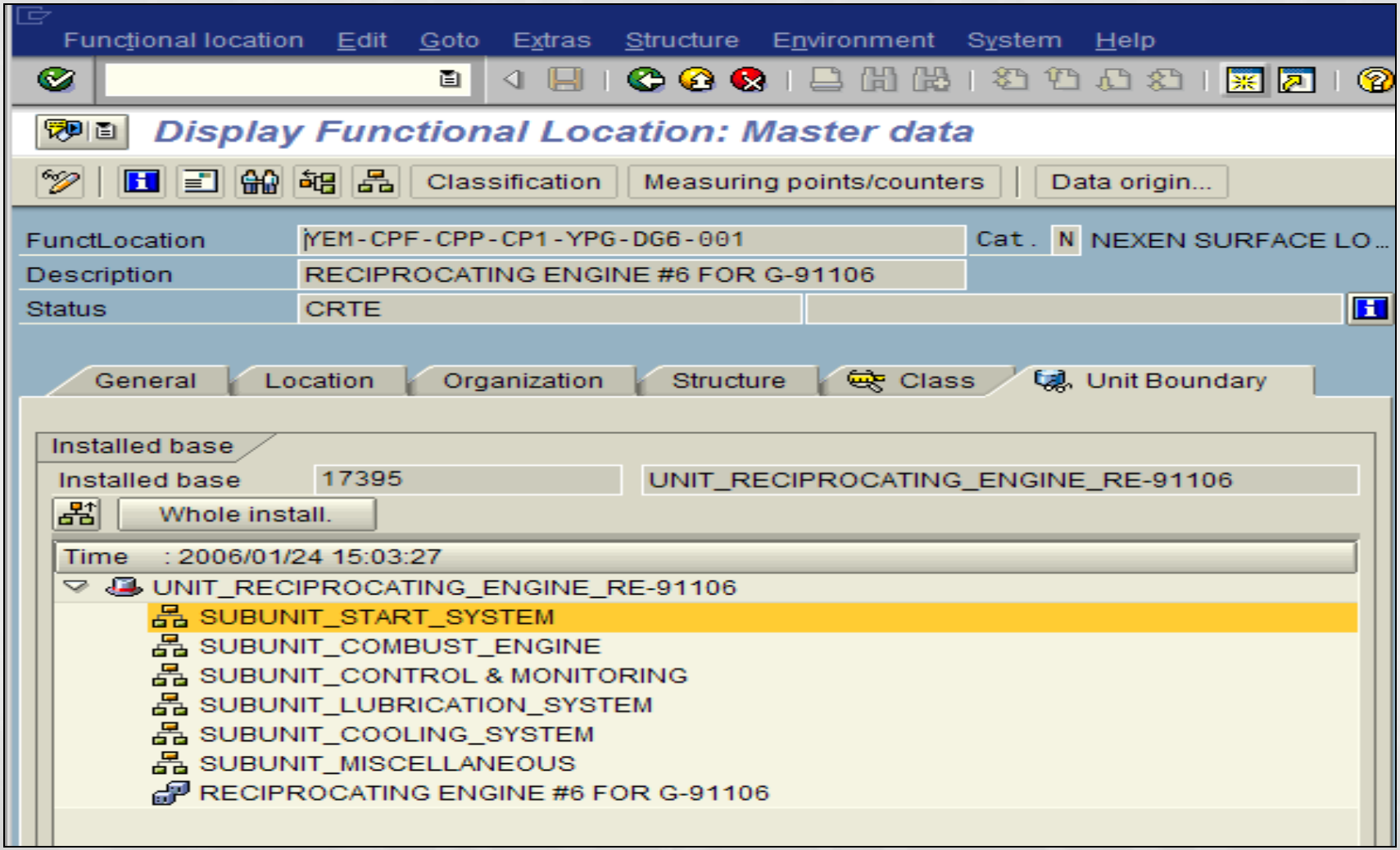
SAP Installed Base: Equipment Unit Boundary Definitions



SAP Installed Base: Equipment Subunit Boundary Definitions



SAP Technical Object Record Boundary Display



Change 2: Capture Detailed Equipment and Reliability Data with Taxonomy

Purpose/Objectives

- Structure for capturing equipment data
  - Characteristic data
    - Support data flow from engineering and procurement to maintenance technical objects (ISO 15926)
  - Reliability data
- Classification of equipment for data analysis purposes
- Verification of equipment capabilities versus functional requirements

ISO 14224 Equipment Classification: Combustion Engines

A.2 Process equipment PE

A.2.1 Combustion engines (piston)

Class: PE_CE_DE_MP

Table A.1 — Taxonomy classification — Combustion engines

Equipment class		Type		Application	
Description	Code	Description	Code	Description	Code
Combustion engines - piston (diesel/gas engines)	CE	Diesel engine	DE	Main power	MP
		Gas engine	GE	Essential power	EP
				Emergency power	EM
				Water injection	WI
				Oil handling	OH
				Gas handling	GH
				Water fire-fighting	FF
				Material handling	MH

ISO 14224 Equipment Characteristics: Combustion Engine

Table 1 — Equipment data

Main categories	Subcategories	Data
Identification	Equipment location	Equipment tag number (*)
	Classification	Equipment unit class, e.g. compressor (see annex A) (*) Equipment type (see annex A) (*) Application (see annex A)(*)
	Installation data	Installation code or name (*) Installation category, e.g. platform, subsea, refinery (*) Operation category, e.g. manned, remote controlled (*) Geographic area, e.g. Southern North Sea, Adriatic Sea, Gulf of Mexico, continental Europe, Middle East
	Equipment unit data	Equipment unit description (nomenclature) Unique number, e.g. serial number Subunit redundancy, e.g. number of redundant subunits
Design	Manufacturer's data	Manufacturer's name (*) Manufacturer's model designation (*)
	Design characteristics	Relevant for each equipment class, e.g. capacity, power, speed, pressure, see annex A (*)
Application	Operation (normal use)	Equipment unit redundancy, e.g. 3 × 50 % Mode while in the operating state, e.g. continuous running, standby, normally closed/open, intermittent Date the equipment unit was installed or date of production start-up Surveillance period (calendar time)(*) The accumulated operating time during the surveillance period Number of demands during the surveillance period as applicable Operating parameters as relevant for each equipment class, e.g. operating power, operating speed, see annex A
	Environmental factors	Ambient conditions (severe, moderate, benign) [a] Interior environment (severe, moderate, benign) [b]
Remarks	Additional information	Additional information in free text as applicable Source of data, e.g. process and instrumentation diagram, data sheet, maintenance system

[a] Features to be considered, e.g. degree of protective enclosure, vibration, salt spray or other corrosive external fluids, dust, heat, humidity.

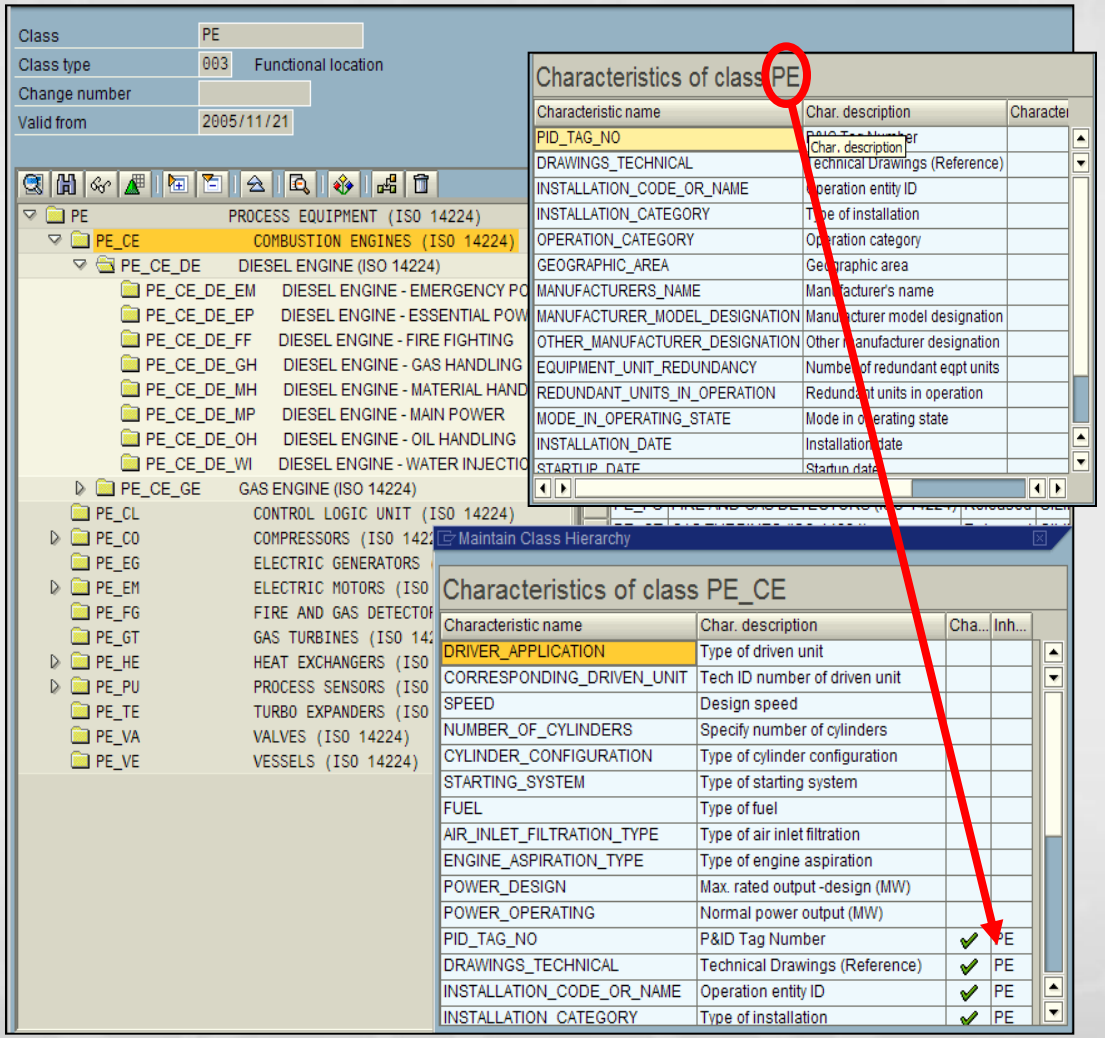
[b] Features to be considered, e.g. for compressor, benign (gas - clean and dry), moderate (some droplets corrosion), severe (sour gas, high CO_2, high particle content).

Table A.3 – Equipment unit specific data – Combustion engines

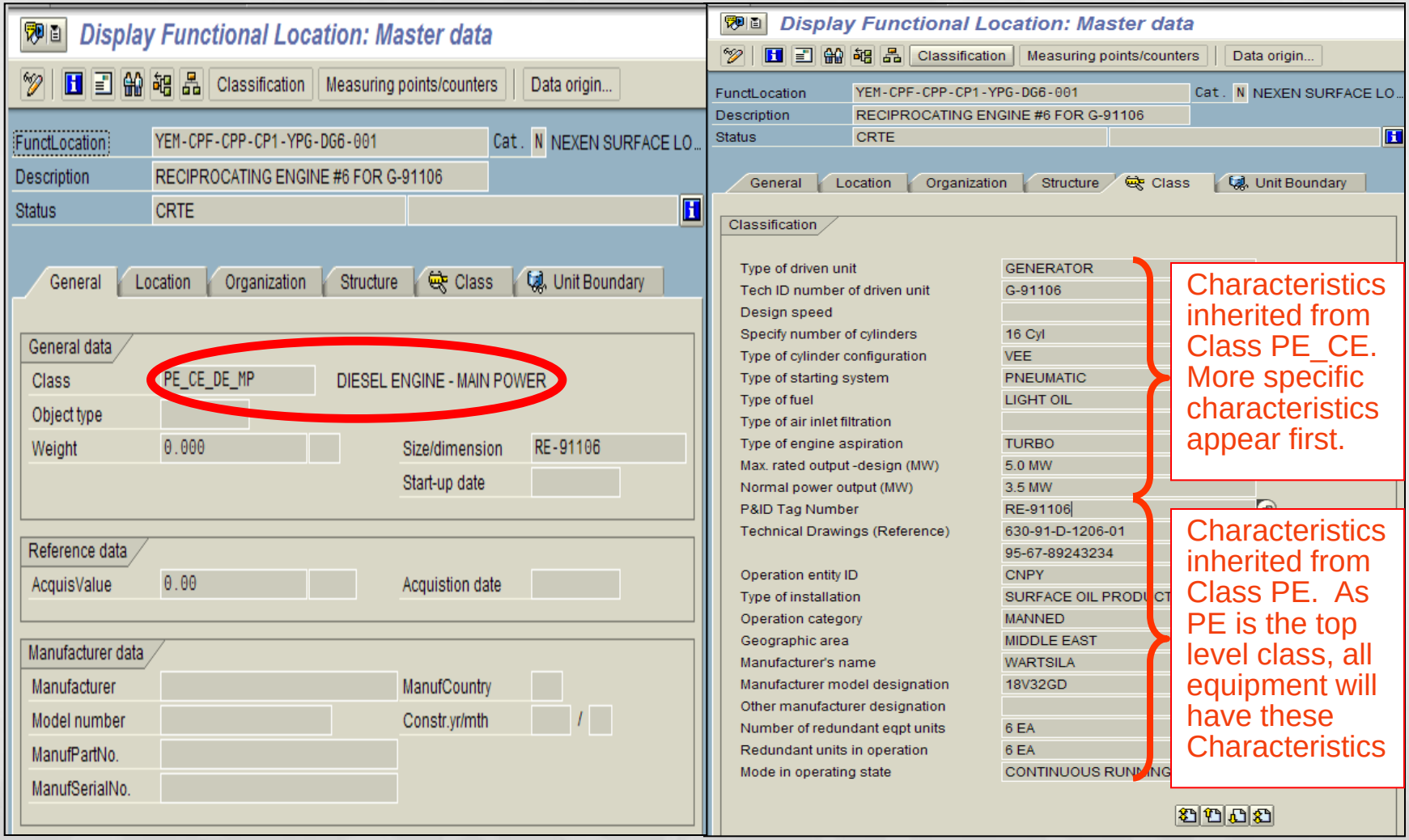
Name	Description	Unit or code list
Driver application (*)	Name of driven unit	Pump, generator, compressor
Corresponding driven unit	Specify identification number of driven unit	Numeric
Power- design (*)	Max. rated output (design)	kW
Power - operating (*)	Specify the approximate power at which the unit has been operated for most of surveillance time	kW
Speed (*)	Design speed	r/min
Number of cylinders	Specify number of cylinders	Integer
Cylinder configuration	Type	Inline, vee, flat
Starting system (*)	Type	Electric, hydraulic, pneumatic
Fuel	Type	Gas, light oil, medium oil, heavy oil, dual
Air inlet filtration type	Type	Free text
Engine aspiration type (*)	Type of engine aspiration	Turbo, natural
(*) Indicates high-priority information.		

SAP Classes and Characteristics: Configuration of ISO 14224

- More specific characteristics appear first
- Green check marks identify inherited characteristics



SAP Classification Assignment to Technical Objects

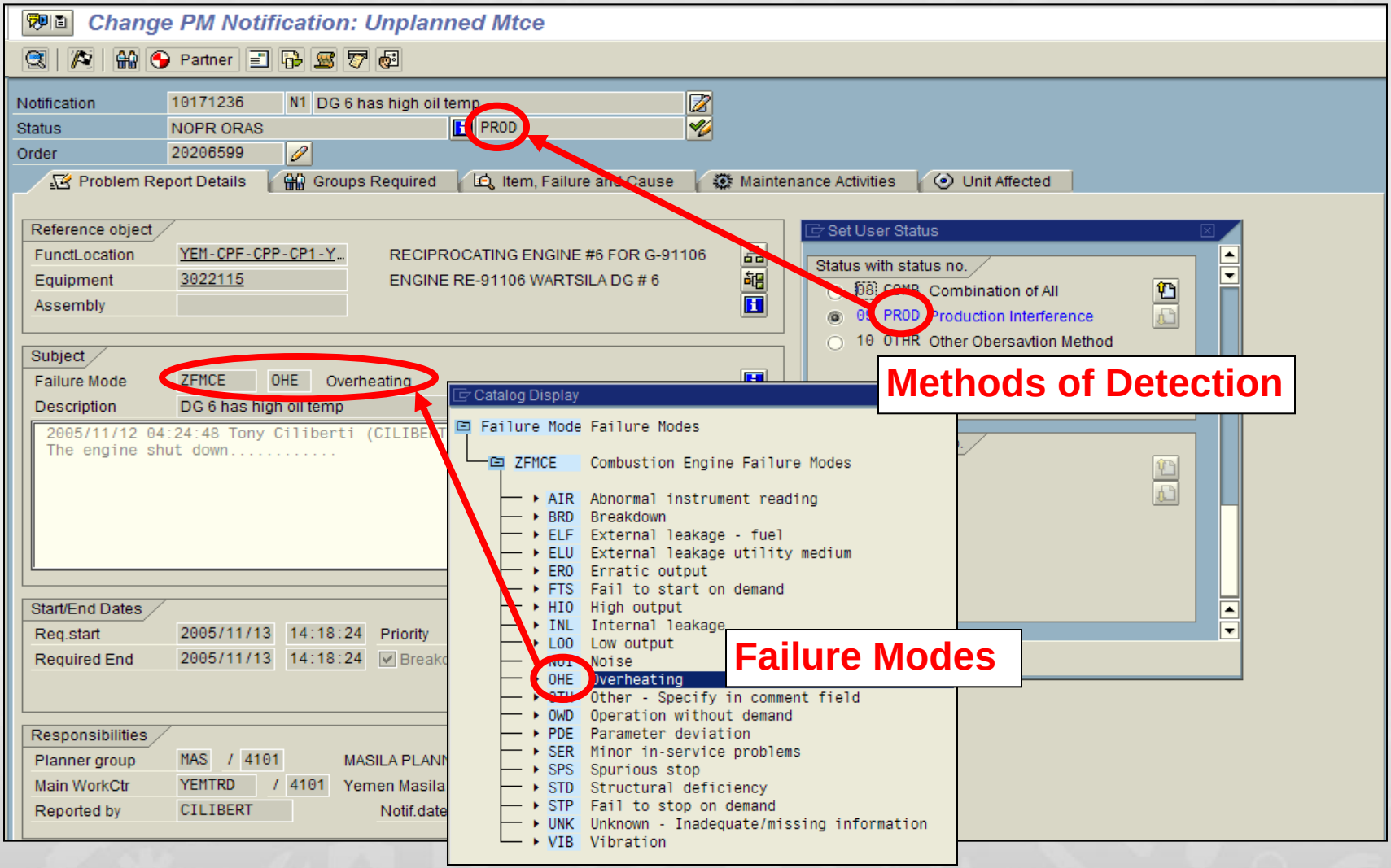


ISO 14224 Failure and Maintenance Notations

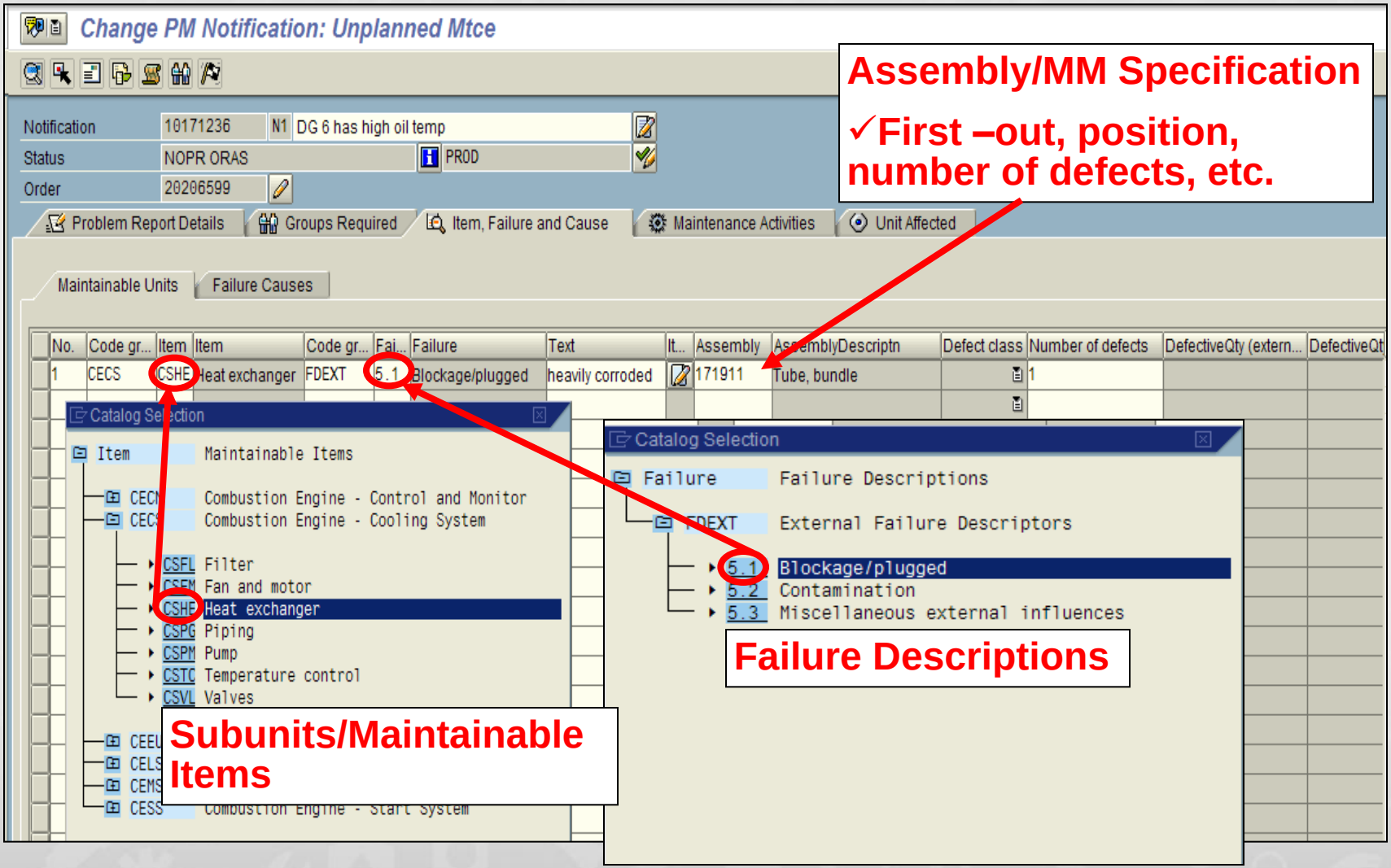
Catalog Codes

- Problem report
  - Failure modes
  - Method of detection
- Repair report
  - Failure descriptors
  - What failed
    - Subunit/maintainable item
    - assemblies/components
  - Failures causes
  - Maintenance activities to repair

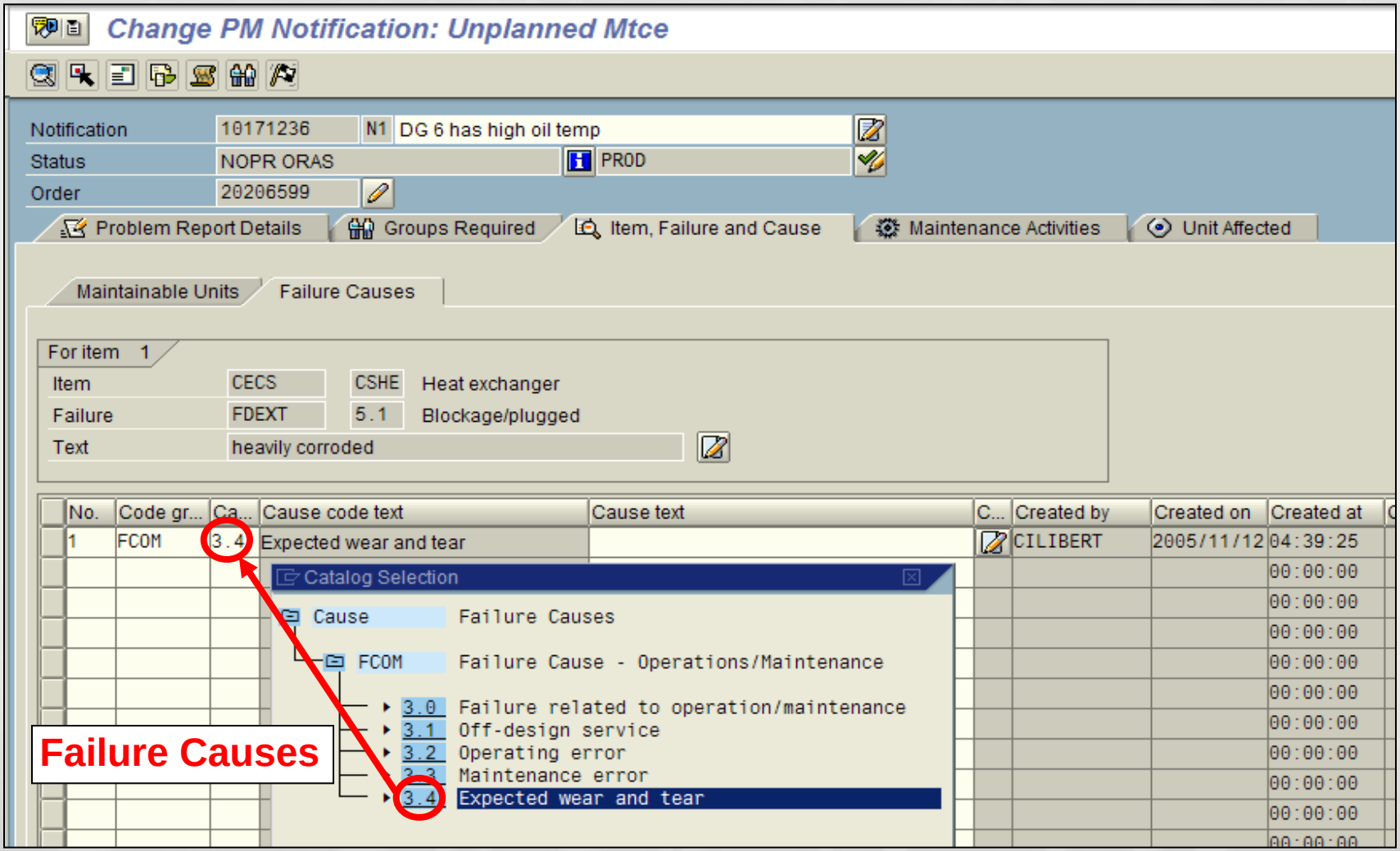
SAP Notification – Problem Report



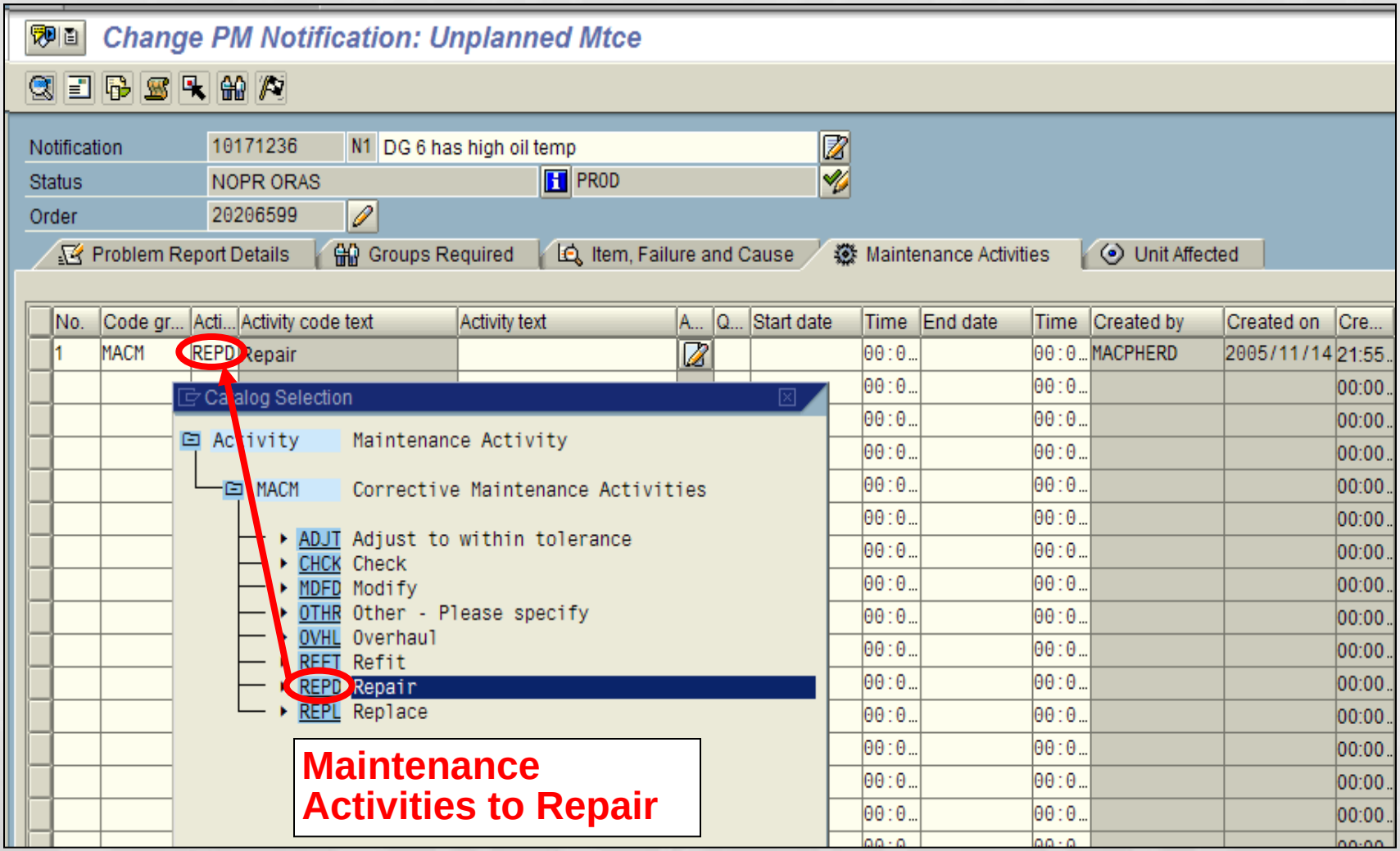
SAP Notification – Repair Report
What Failed and How



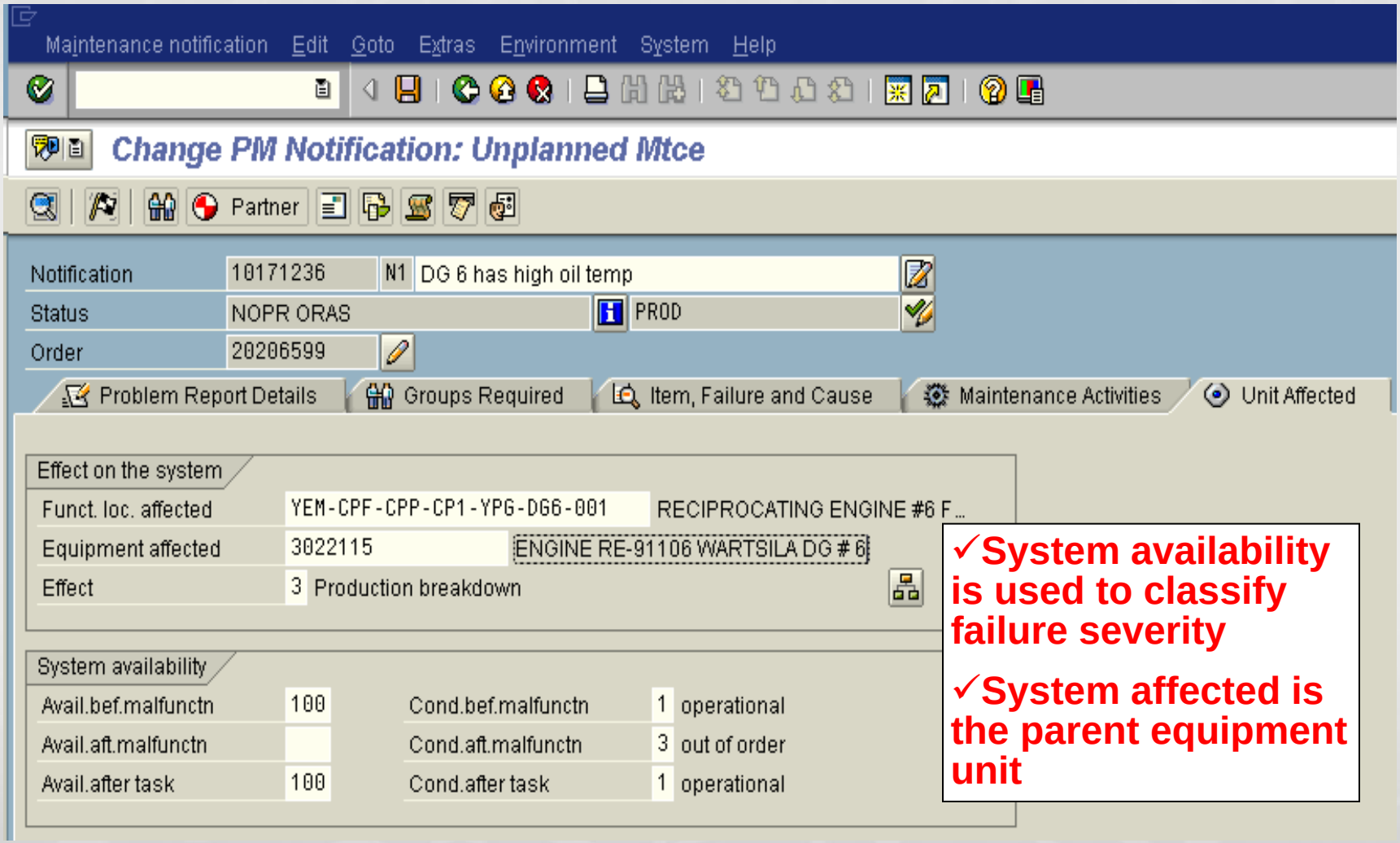
SAP Notification – Repair Report Failure Cause for Maintainable Item



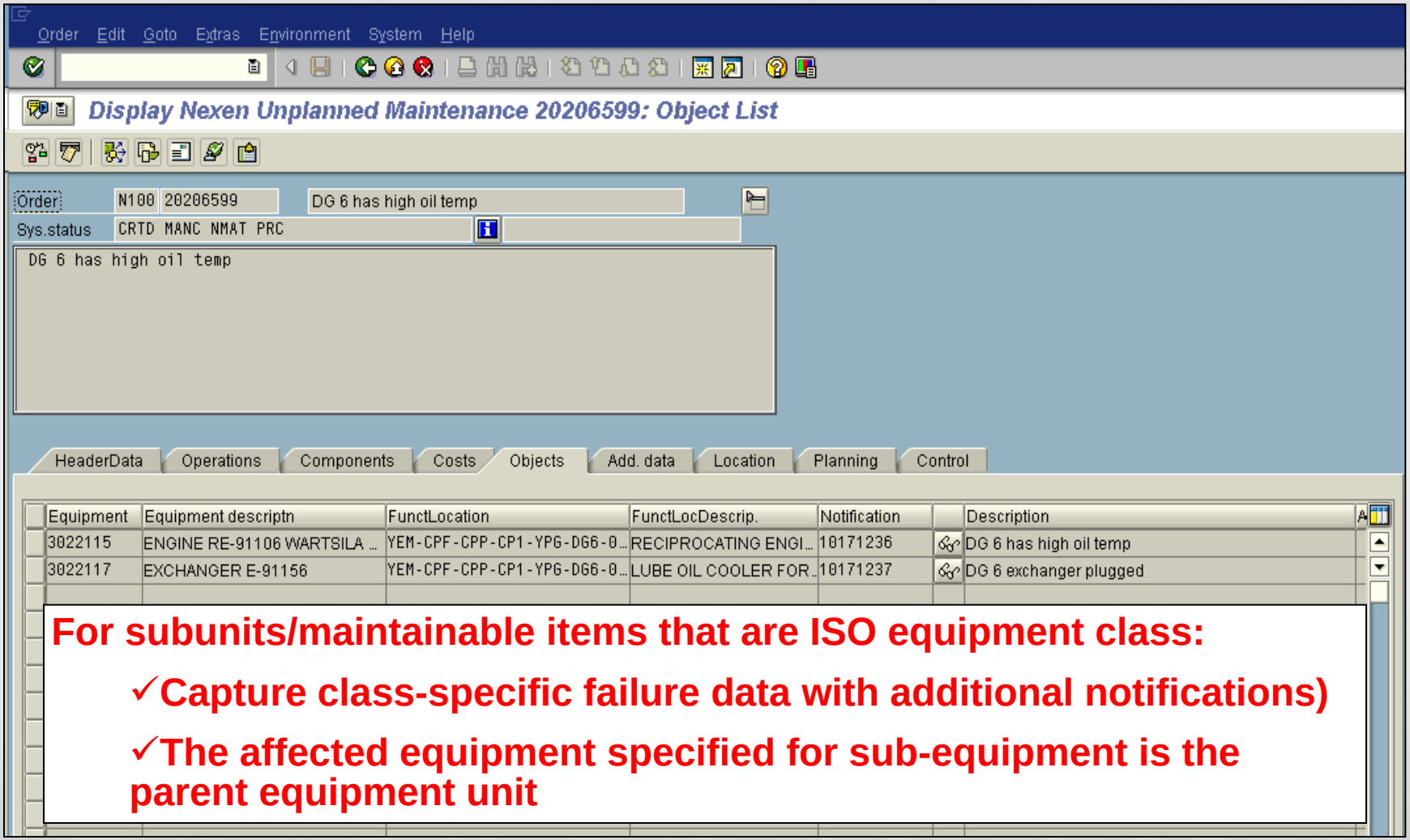
SAP Notification – Repair Report Maintenance Activities



SAP Notification – Equipment Unit Affected and How



Capturing Multiple Equipment Class Data Within One Equipment Unit Failure



For subunits/maintainable items that are ISO equipment class:

- ✓Capture class-specific failure data with additional notifications)
- ✓The affected equipment specified for sub-equipment is the parent equipment unit

ISO 14224 Equipment Class Interpretation

- Standard Interpretation of ISO 14224
  - Equipment to include/exclude
  - Clarifications of Class Boundary
    - Components to include/exclude
  - Repairs to include/exclude
  - KPI definitions

	Machinery Indicators	Key Performance Indicators
	PUMPS	MP Section 2-2-1 / Page 1 of 6
		JUNE, 1998

1. PUMP KPI TAXONOMY

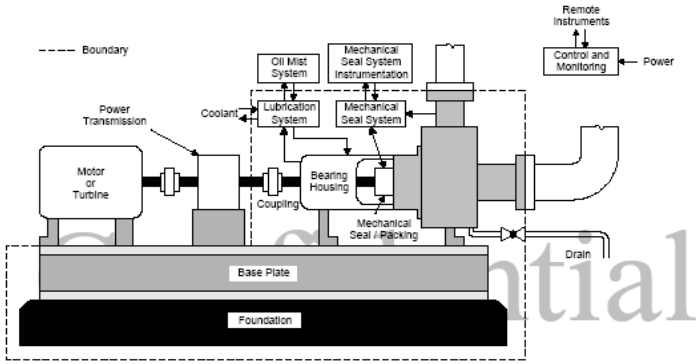


Figure 1 - Pump Equipment Class Boundary
See Section 3.3 for a list of components included or excluded from the pump equipment class boundary.

2. REFERENCES

3. DEFINITIONS TO BE APPLIED FOR DEVELOPING PUMP INDICATORS

3.1 Definition of a Pump

For the purposes of tracking performance indicators and costs, a pump is defined as a machine which increases the pressure of a liquid from the suction to discharge pressure and includes all necessary supporting systems such as lubrication systems and seal support systems as shown in Figure 1. The pump driver is excluded from the pump envelope. The coupling mounted on the pump is included in the envelope but all other power transmission devices on the pump set are excluded. In addition, the driver site rated power must be **greater than 1 hp** (in North America) or **equal to or greater than 1 kW** (outside North America). Table 1 below provides additional clarification on what pump types are to be included and excluded from the definition of a pump.

Table 1 - Types of Pumps Included/Excluded in the Pump Definition

Example from Meridium

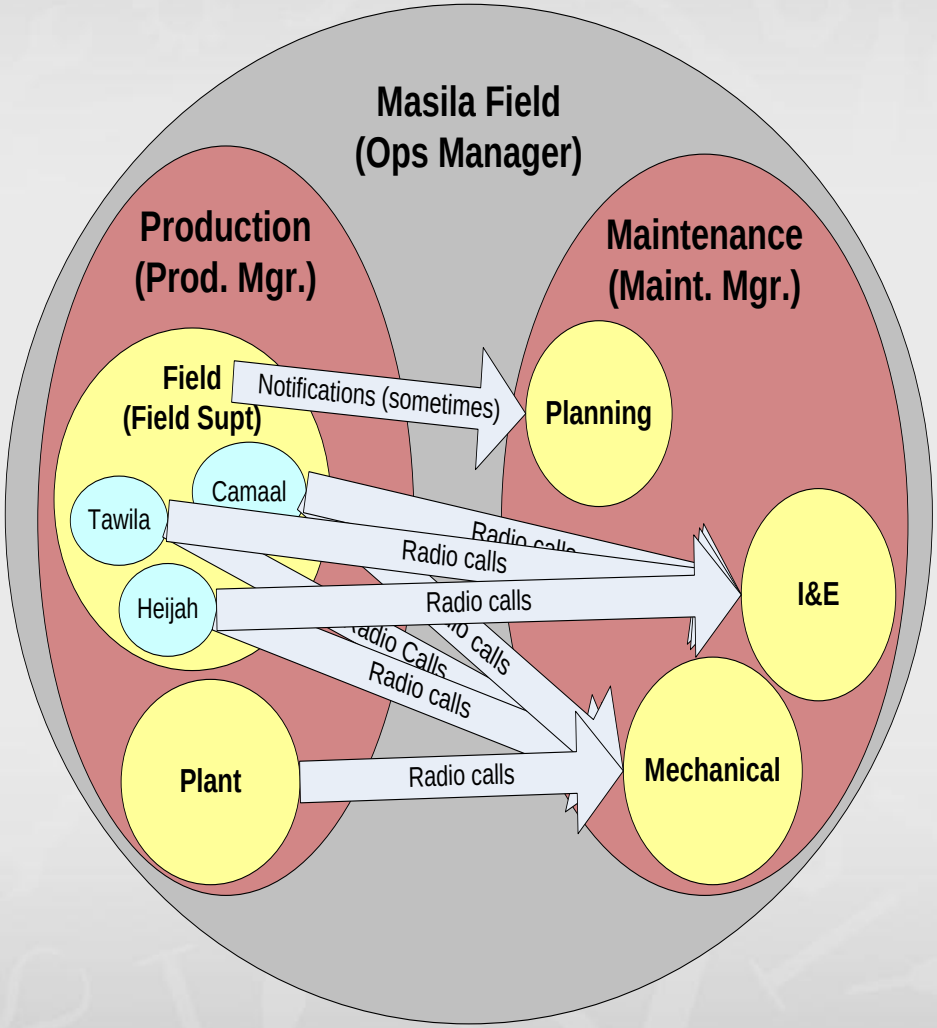
Change 3: Modify Work Processes for Complete and Accurate Data Capture

- Make SAP the single source of information
- Modify work notification process to ensure that all jobs are captured
- Customize SAP to support/enable new functionality

Work Notification Process
Emergency Workflow – Existing

Current Issues

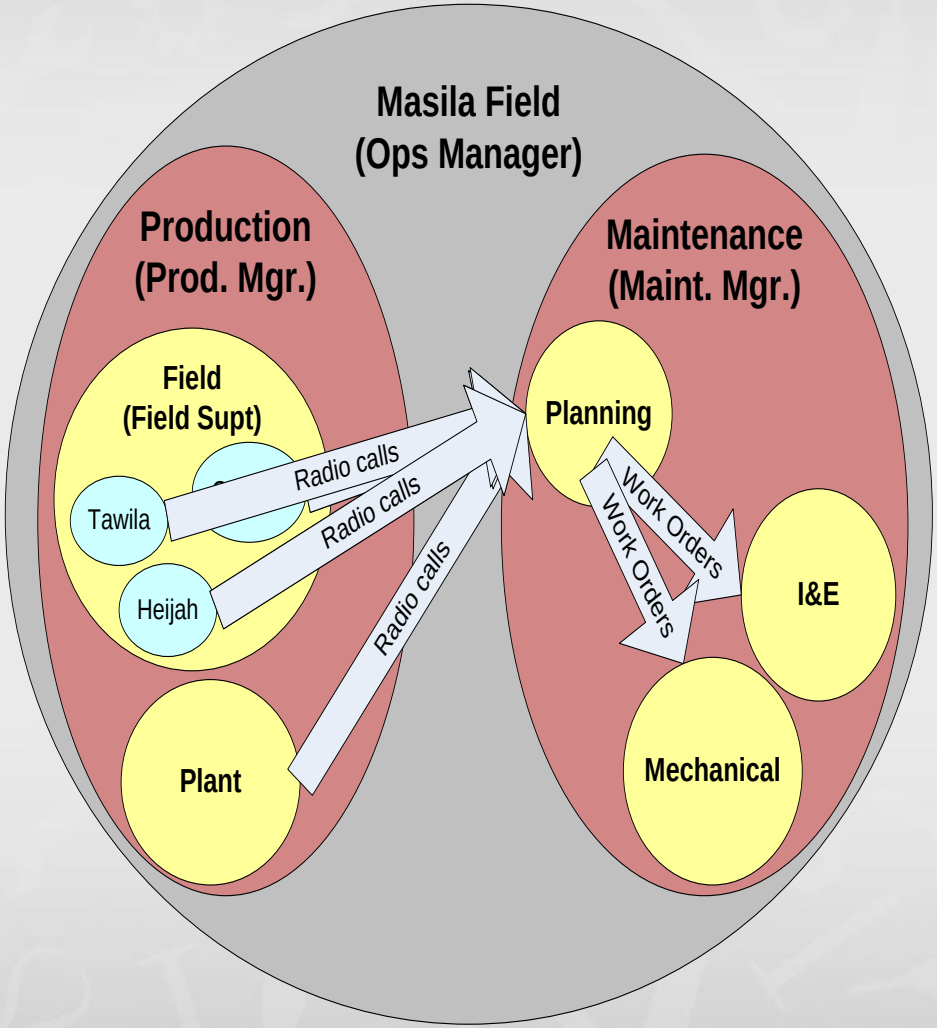
- Incomplete and improper allocation of costs and reliability data
  - N1 notifications not issued or issued after work completion
  - Improper notification sequence (N4 done before N1)



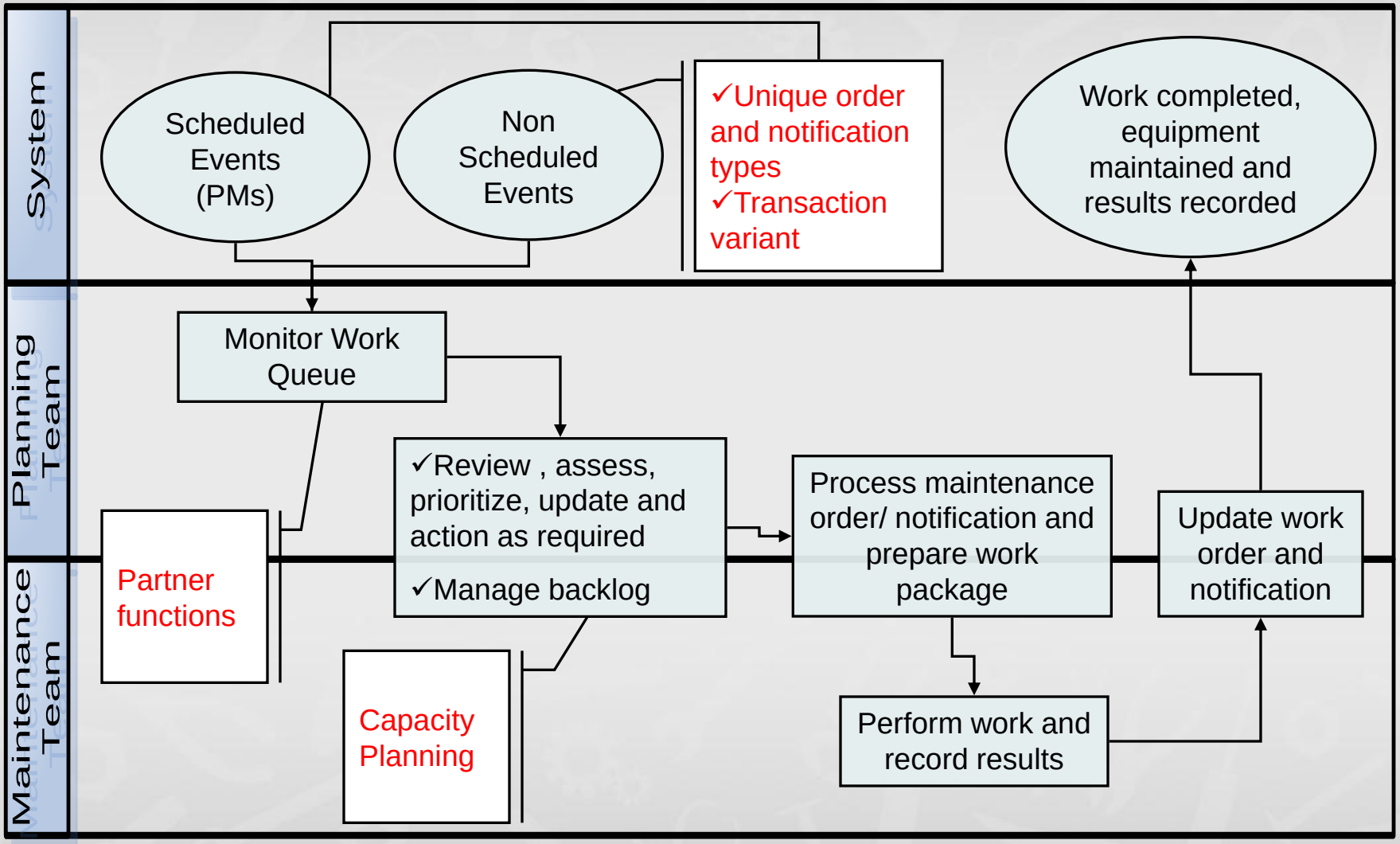
Work Notification Process
Emergency Workflow – After Changes

Benefits Realization

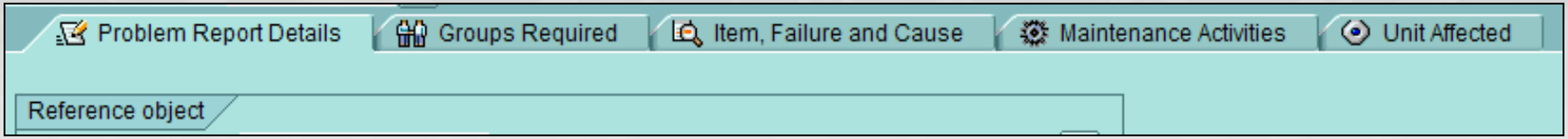
- Proper allocation of costs and reliability data to technical objects
  - All jobs captured with discrete and detailed work orders
  - Notification sequence done properly



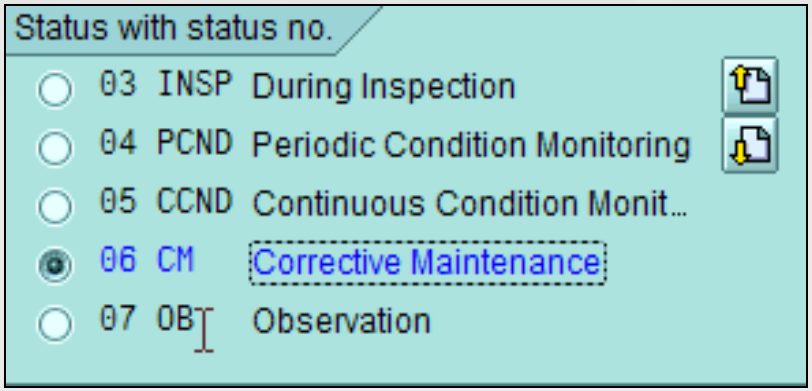
Order and Notification Processing



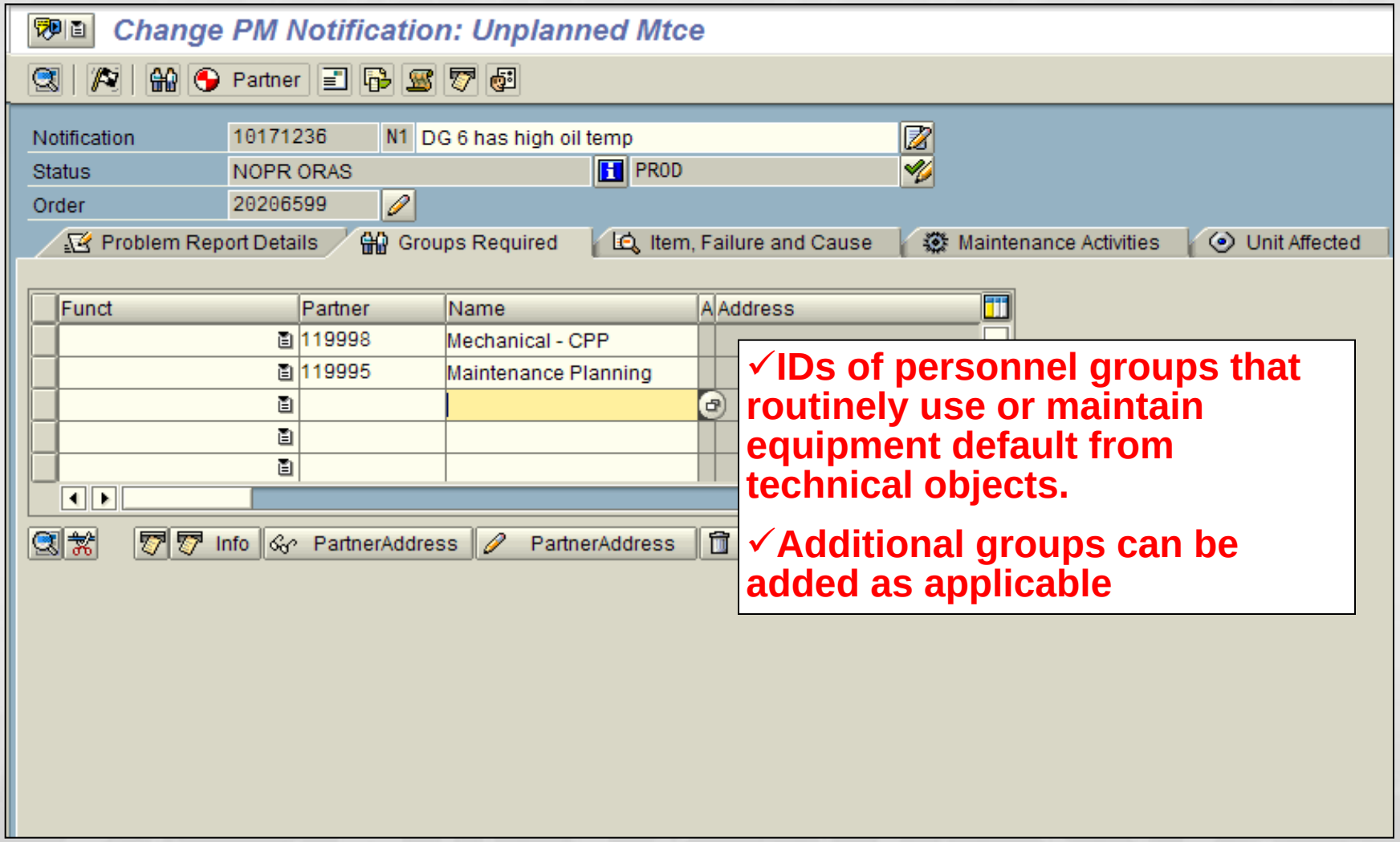
Notification Changes



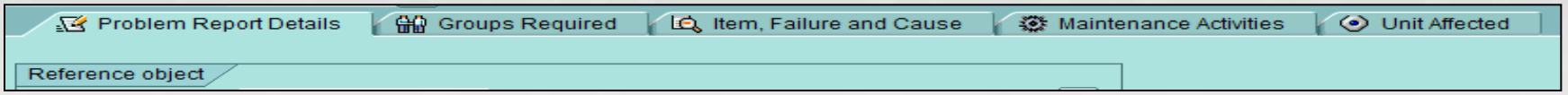
- New Tabs in N1 type notification
  - Problem Report Details
  - Groups Required
  - Items, Failure and Causes
  - Maintenance Activities
  - System Affected
- New User Status Profile
  - To categorize how the problem was discovered

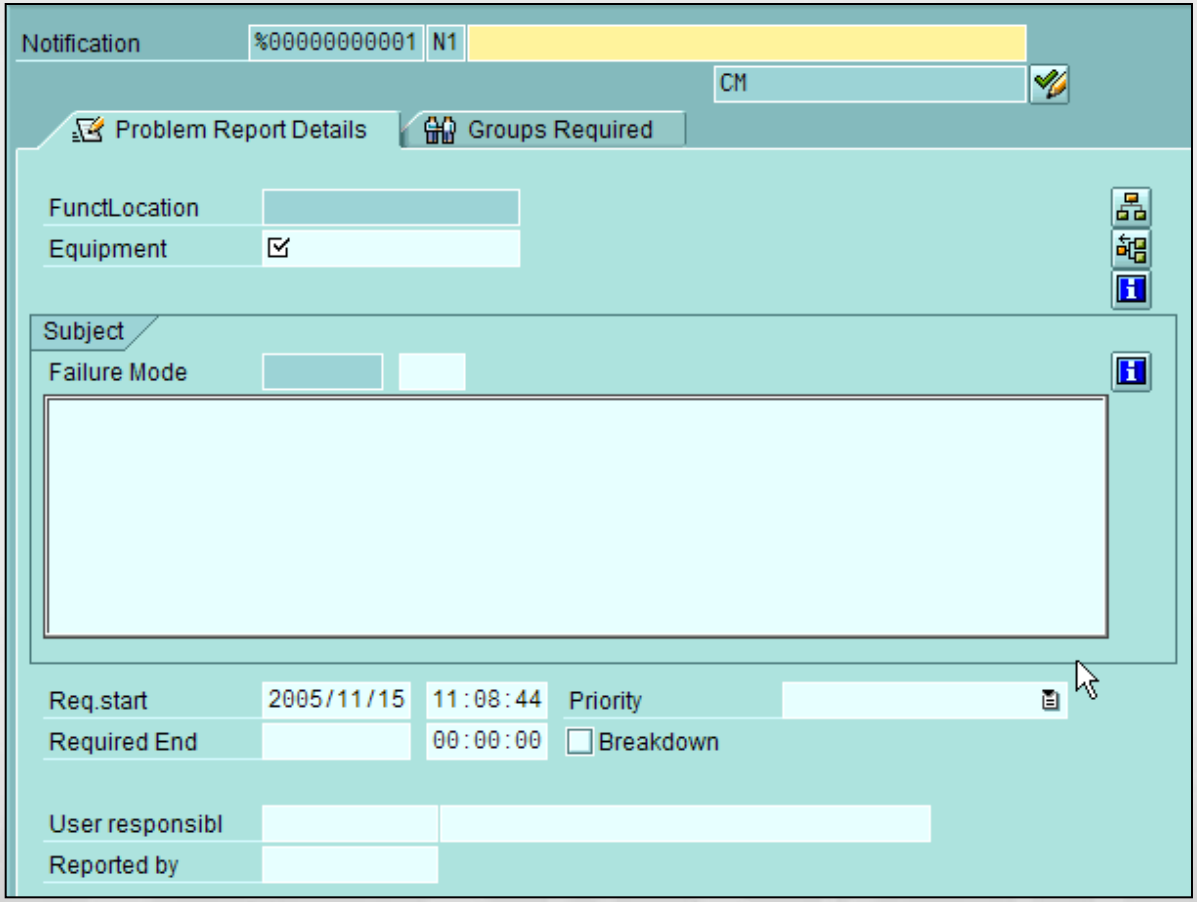


SAP Notification – Partner Functionality



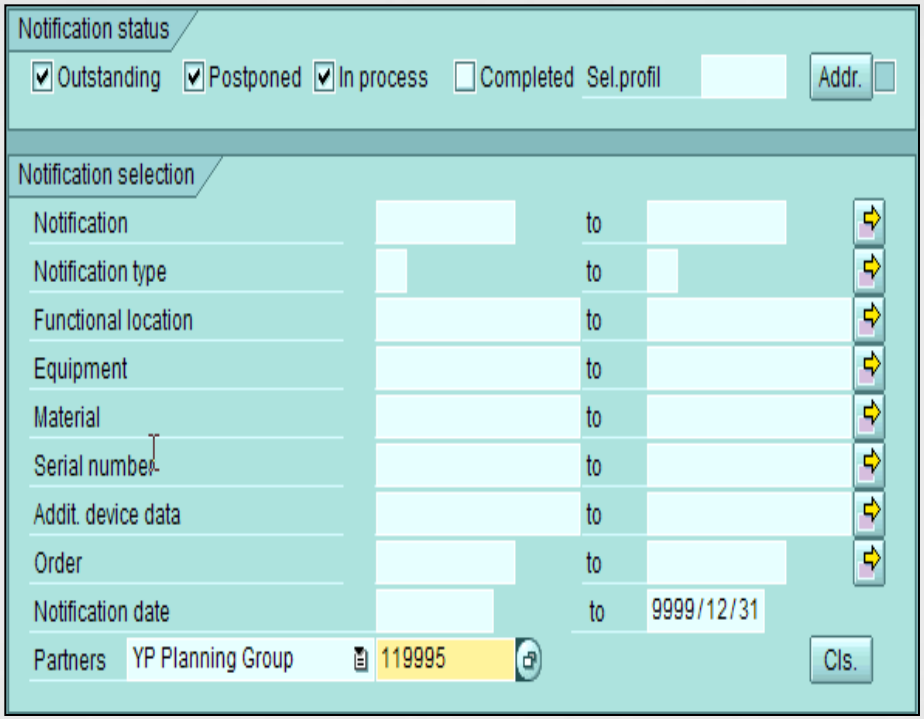
Transaction Variants – Notification Create





Transaction Variants – “Queues” / List Edits

- Standard List Edits / Queues
- Standard variants per group (selection and display)



Req.start	Req. ti...	Notification	Description	Order	Description of functional location	Description of technical object	Equipment
2005/11/13	14:18:24	10171236	DG 6 has high oil temp	20206599	RECIPROCATING ENGINE #6 FOR G-...	ENGINE RE-91106 WARTSILA DG # 6	3022115
2005/11/12	14:51:22	10171237	DG 6 exchanger plugged	20206599	LUBE OIL COOLER FOR RE-91106	EXCHANGER E-91156	3022117

Summary of SAP System Changes

- Configuration changes
  - Catalog profiles and content
  - Notification screen templates
  - Functional location structure indicator
  - User status profile
- Classification
  - Class hierarchy
- Enhancements
  - Notification content
    - EXIT_SAPMIWO0_020
  - Equipment record content
    - EXIT_SAPMIEQ0_001

- Transaction simplification
  - Transaction variant
  - GUI xt
  - On-screen notification close-out process
  - Spares ordering
- Queuing by discipline
  - Partner functionality
  - Customized work lists based on partner ID
- Reporting to support new functionality
  - BIW web applications / queries
  - PM content to BW

Data and Technical Administration

- Centralized data repository with common technical and costing design
  - Master data is the foundation of sound end to end business processes
- Centralized support for technical design
  - ISO 14224 interpretations and performance measures
  - Part of the change management and governance process
- Local business ownership of data and results

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Driving Value from SAP-Centric EAM

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