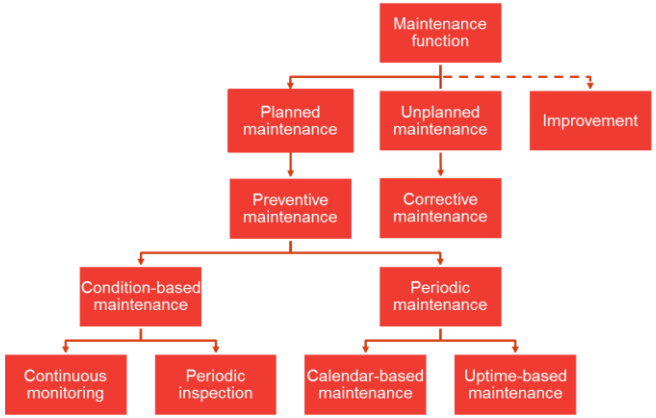
Lundin
Energy Norway

Condition Based Maintenance

Presentation for USN

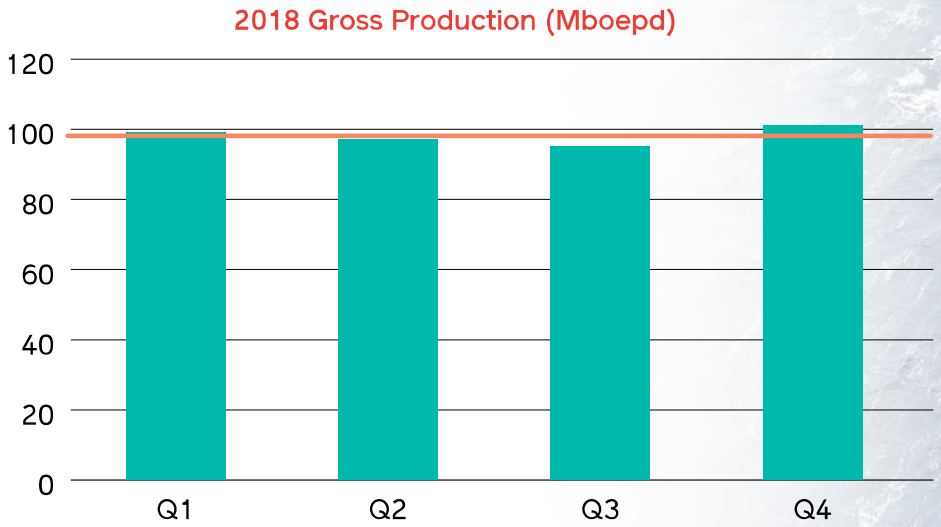
The basics


Goals and requirments
Maintenace Program
Planning and scheduling
Maintenance execution
Organisation
Materials
Documaentation and IT systems
Resource needs
Management and verification
Technical condition
Risk level
Availability
Maintenance cost
Improvement
Analysis
Reporting


Maintenance function
Planned maintenance
Unplanned maintenance
Improvement
Preventive maintenance
Corrective maintenance
Condition-based maintenance
Periodic maintenance
Continuous monitoring
Periodic inspection
Calendar-based maintenance
Uptime-based maintenance

Strong Operating Performance

- Production efficiency: 97.5% 2018 (96% 2019 assumption)
- Well capacity double available facilities capacity
- Production outlook reflects contractual capacity allocation - 90 Mboepd for Edvard Grieg out of 145 Mboepd (2)



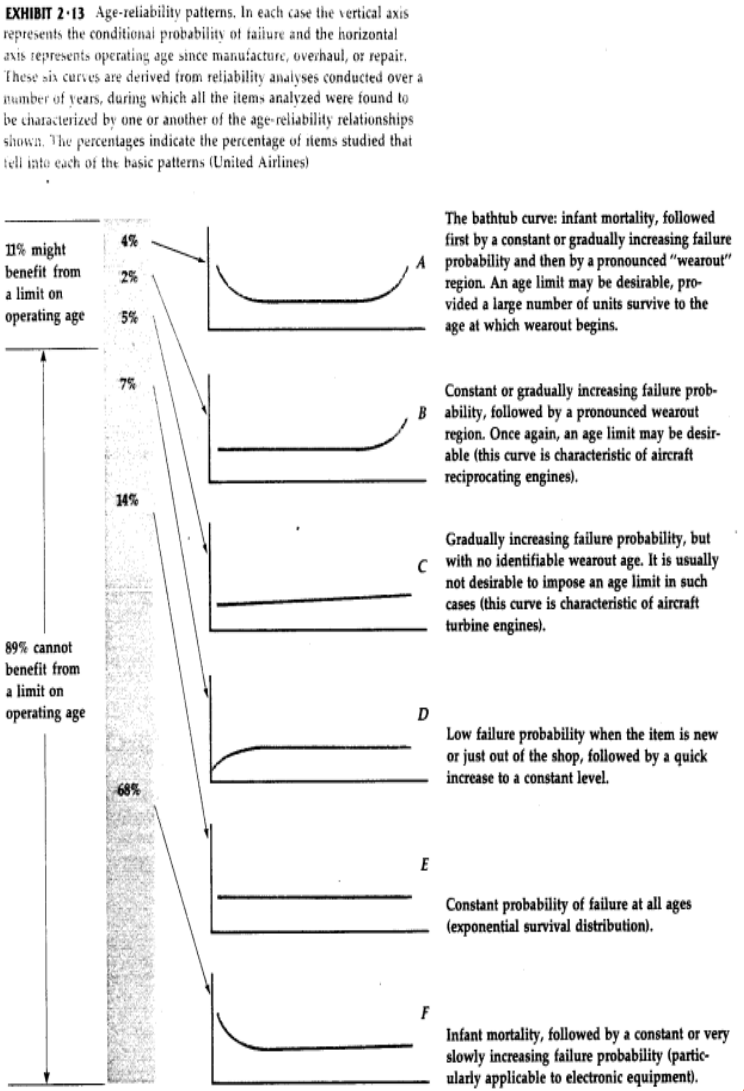
(1) 2018 actual, includes tariff netting
(2) Excludes gas and NGL's

OPEX 3.95 USD/boe (1)

Why Condition Based Maintenance?

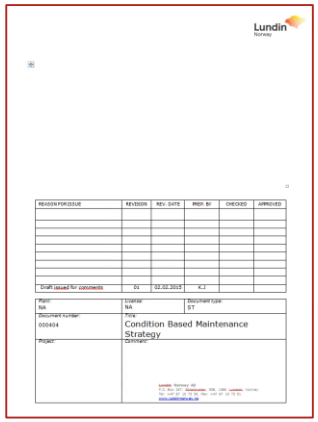
- Only about 15% to 20% of equipment failures are age related
  - The other 80% to 85% being totally time-random events
- Calendar/running hrs based maintenance will typically result in
  - Too frequent maintenance
  - Increased risk of maintenance induced failures
  - Infant mortality issues
  - Safety issues?!

- With only about 15% to 20% of your equipment failures being age related, and the other 80% to 85% being totally time-random events, how can you improve the uptime of your plant and facility?



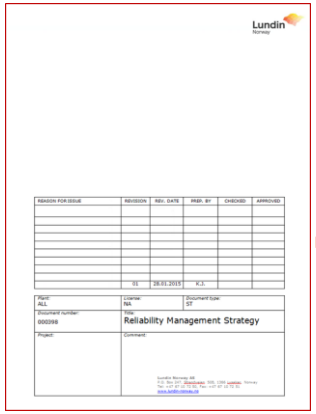
Reliability-Centered Maintenance, F.S. Nowlan et al (1978)

What do we want to achieve??


Lundin Norway

REASON FOR ISSUE	REVISION	REV. DATE	PREP. BY	CHECKED	APPROVED
Draft issued for comments	01	02.02.2015	K.J		

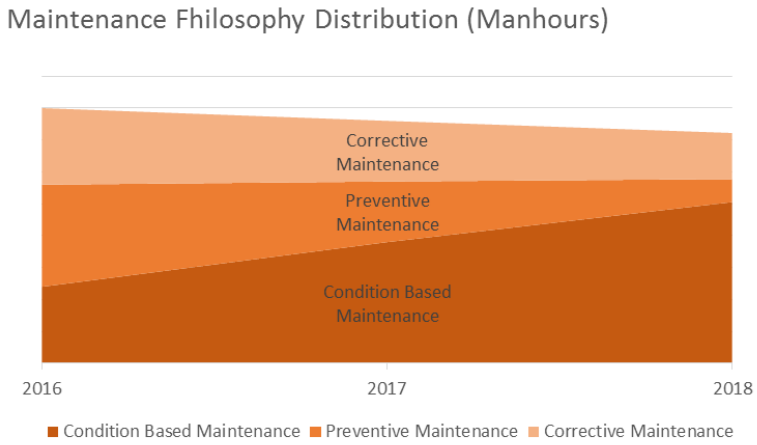
Plant: NA	License: NA	Document type: ST
Document number: 000404	Title: Condition Based Maintenance Strategy	
Project:	Comment:	


Lundin Norway

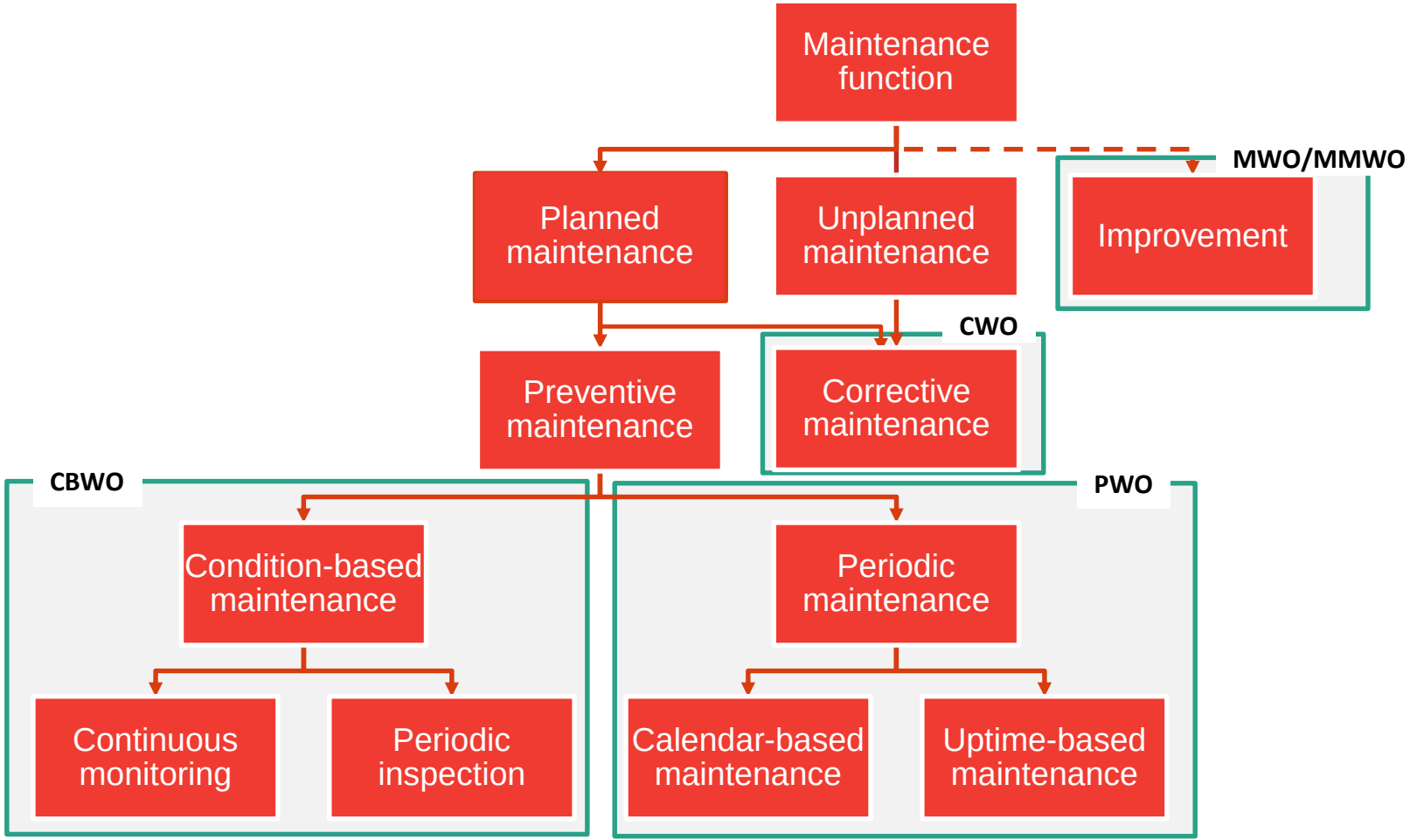
REASON FOR ISSUE	REVISION	REV. DATE	PREP. BY	CHECKED	APPROVED
	01	28.01.2015	K.J.		

Plant: ALL	License: NA	Document type: ST
Document number: 000398	Title: Reliability Management Strategy	
Project:	Comment:	

- Reliability vision: LNAS vision is to establish a reliability management process which results in **zero unplanned** equipment failures.
- CBM vision: LNAS vision is to achieve **x% deployment of condition based maintenance** as basis for realizing reliability objectives and cost objectives associated with the maintenance function.
- The objective is to:
  - Fully utilize the benefits of condition monitoring in place as well as to evaluate additional applications
  - Maximize equipment reliability and availability
  - Minimise maintenance interventions and costs

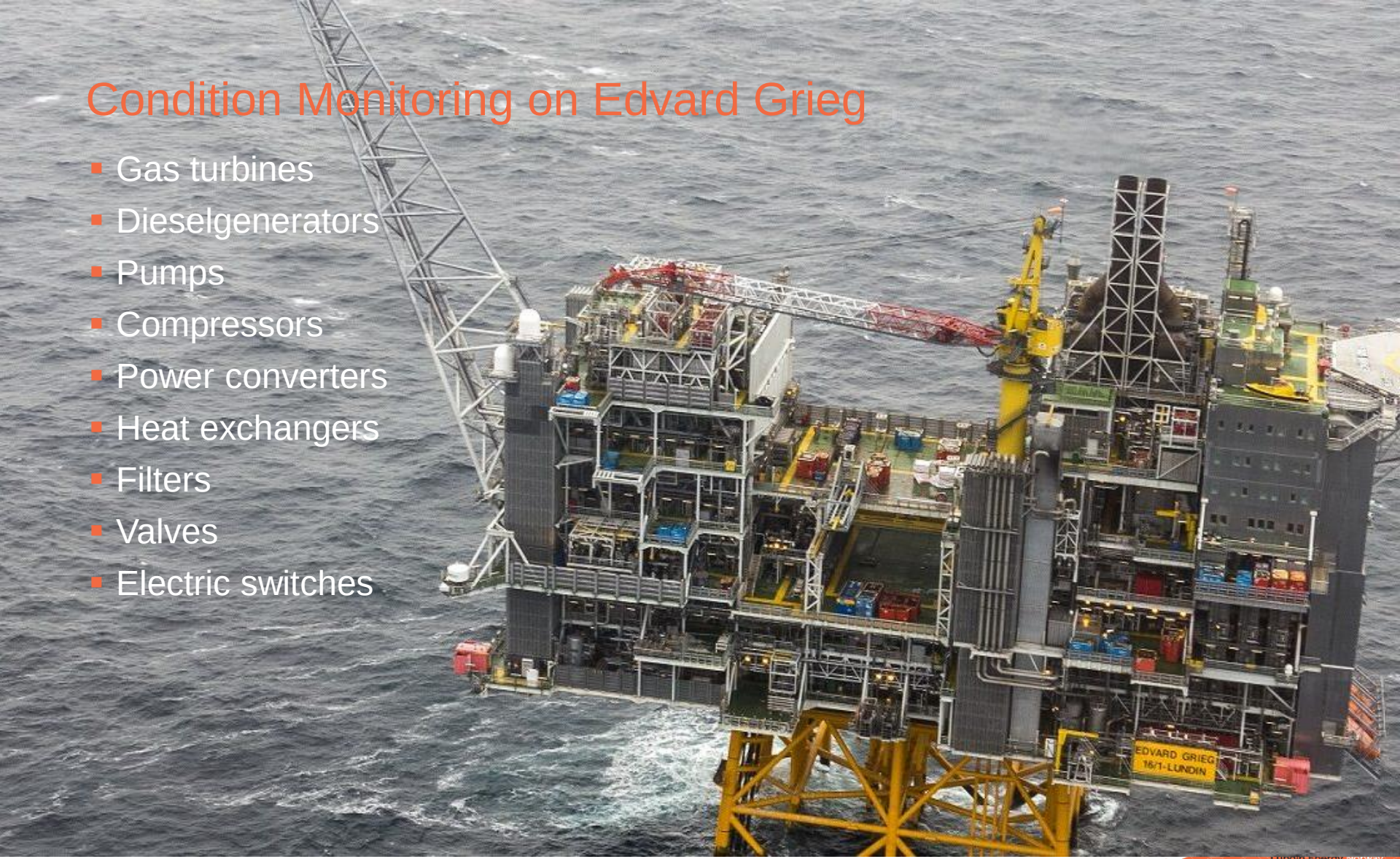


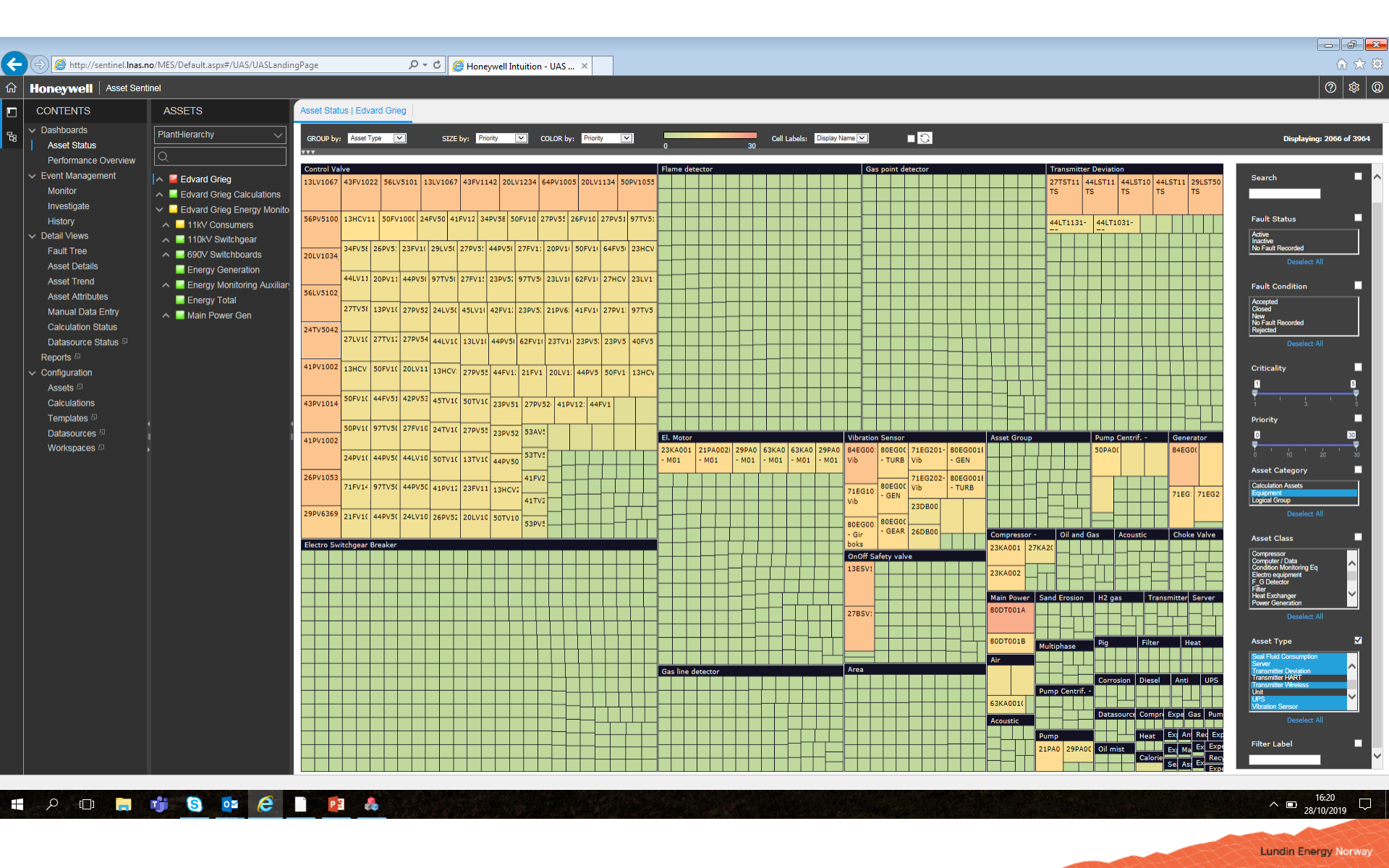
Maintenance categories with todays work order setup



Condition Monitoring on Edvard Grieg

- Gas turbines
- Dieselgenerators
- Pumps
- Compressors
- Power converters
- Heat exchangers
- Filters
- Valves
- Electric switches




http://sentinel.lnas.no/MES/Default.aspx#/UAS/UASLandingPage
Honeywell Intuition - UAS ...
Honeywell | Asset Sentinel
CONTENTS
Dashboards
Asset Status
Performance Overview
Event Management
Monitor
Investigate
History
Detail Views
Fault Tree
Asset Details
Asset Trend
Asset Attributes
Manual Data Entry
Calculation Status
Datasource Status
Reports
Configuration
Assets
Calculations
Templates
Datasources
Workspaces
ASSETS
PlantHierarchy
Edvard Grieg
Edvard Grieg Calculations
Edvard Grieg Energy Monito
11kV Consumers
110kV Switchgear
690V Switchboards
Energy Generation
Energy Monitoring Auxiliar
Energy Total
Main Power Gen
Asset Status | Edvard Grieg
GROUP by: Asset Type
SIZE by: Priority
COLOR by: Priority
0
30
Cell Labels: Display Name
Displaying: 2066 of 3964
Control Valve
Flame detector
Gas point detector
Transmitter Deviation
El. Motor
Vibration Sensor
Asset Group
Pump Centrif. -
Generator
Electro Switchgear Breaker
OnOff Safety valve
Compressor -
Oil and Gas
Acoustic
Choke Valve
Gas line detector
Area
Main Power
Sand Erosion
H2 gas
Transmitter
Server
Multiphase
Pig
Filter
Heat
Corrosion
Diesel
Anti
UPS
Pump Centrif. -
Pump
Oil mist
Search
Fault Status
Active
Inactive
No Fault Recorded
Deselect All
Fault Condition
Accepted
Closed
New
No Fault Recorded
Rejected
Deselect All
Criticality
Priority
Asset Category
Calculation Assets
Equipment
Logical Group
Deselect All
Asset Class
Compressor
Computer / Data
Condition Monitoring Eq
Electro equipment
F_G Detector
Filter
Heat Exchanger
Power Generation
Deselect All
Asset Type
Seal Fluid Consumption
Server
Transmitter Deviation
Transmitter HART
Transmitter Wireless
Unit
UPS
Vibration Sensor
Deselect All
Filter Label
16:20
28/10/2019
Lundin Energy Norway

Overview CM system

El.actuated valves

65 El. actuated valves

Honeywell IMS

Sand detection

Sand/Erosion monitoring

Corrosion monitoring

14 Acuostic Sand detection sensors

14 Sand/Errosion sensors

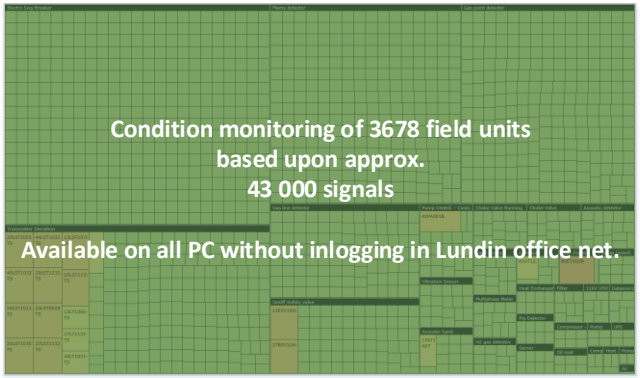
14 Sand/Errosion sensors

ROXAR Fieldwatch

Vibration monitoring

Vibration analysis of **18** Rotating equipm. Approx. **216** signals

Bently Nevada System 1



Turbine & Piston compressors

690V motors Power consum. calculation

Heat exchangers

Diesel leakage prediktion, Main Power turbine

Choke valves

Energy monitoring

Main Power Turbines

Critical Servers

Pumps

Fire water pumps

Filters

Calory measurement for Fuelgas

SAS Analysis based upon 3687 measurements

197 Process Transmitters Measurement deviation analysis

1691 Process Transmitters Approx. 15219 status signals

Honeywell IMS

HART / SAS

Process transmitters

205 Safety valves Traveltime, Ability to reach safe position

67 Safety valves Friction/Leakage monitoring

Honeywell IMS

Score VMAP

Safety valves

176 Control valves. Approx. **8600** signals

Emerson Valvelink

Control valves

468 F&G detectors Approx. **2340** status signals

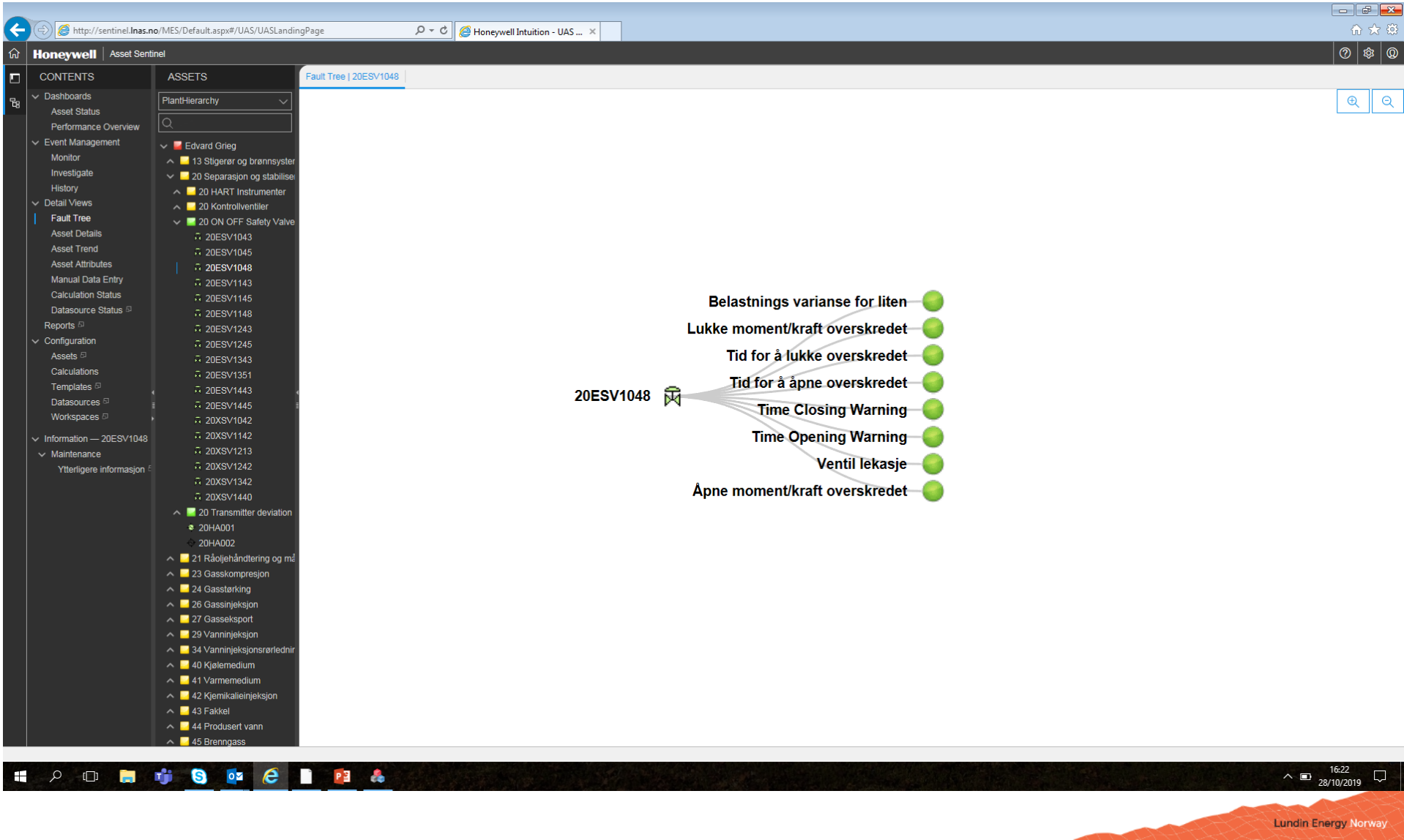
SAS

F&G detectors

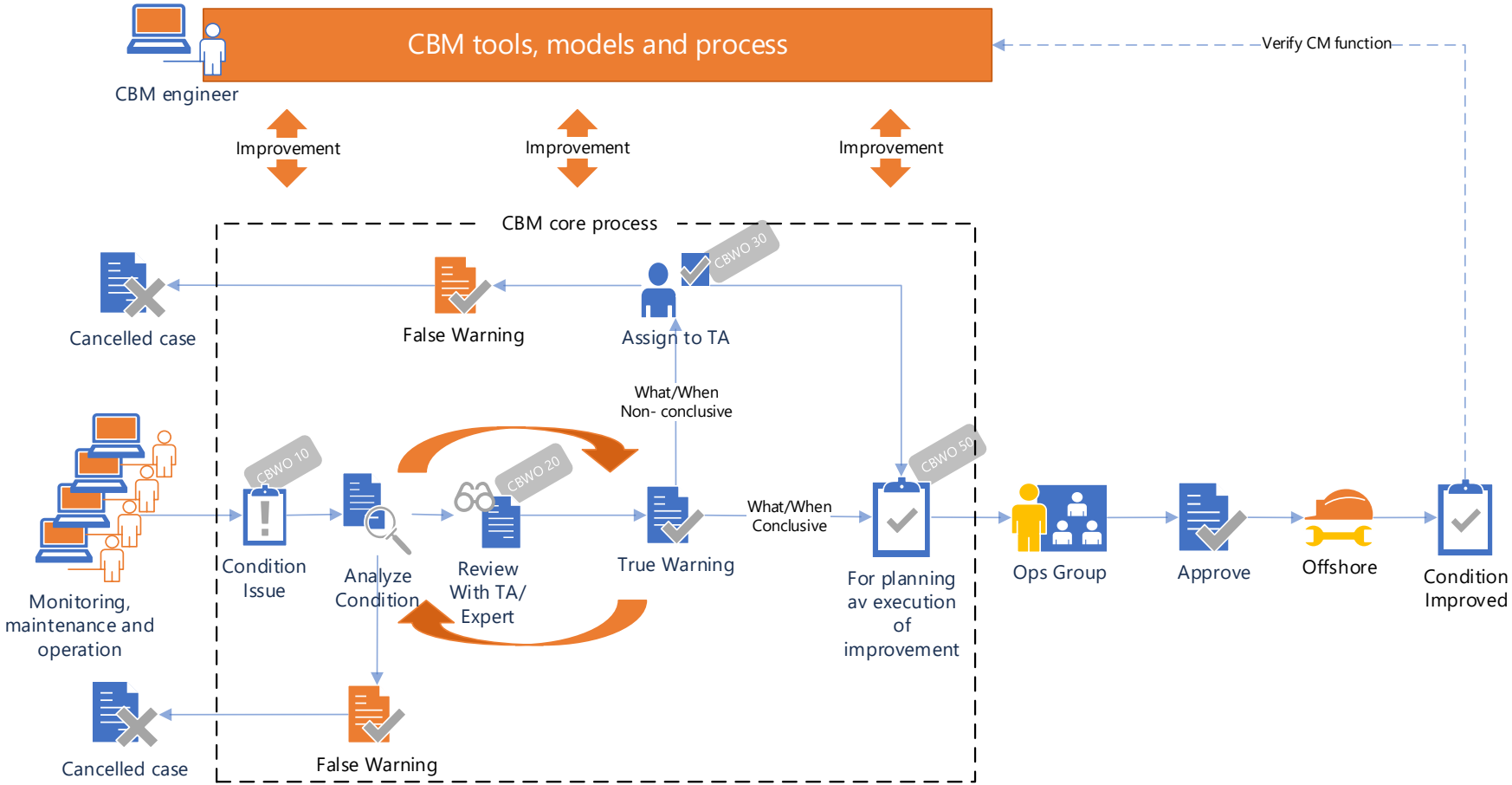
414 Electrical breakers (all) Approx. 10800 signals

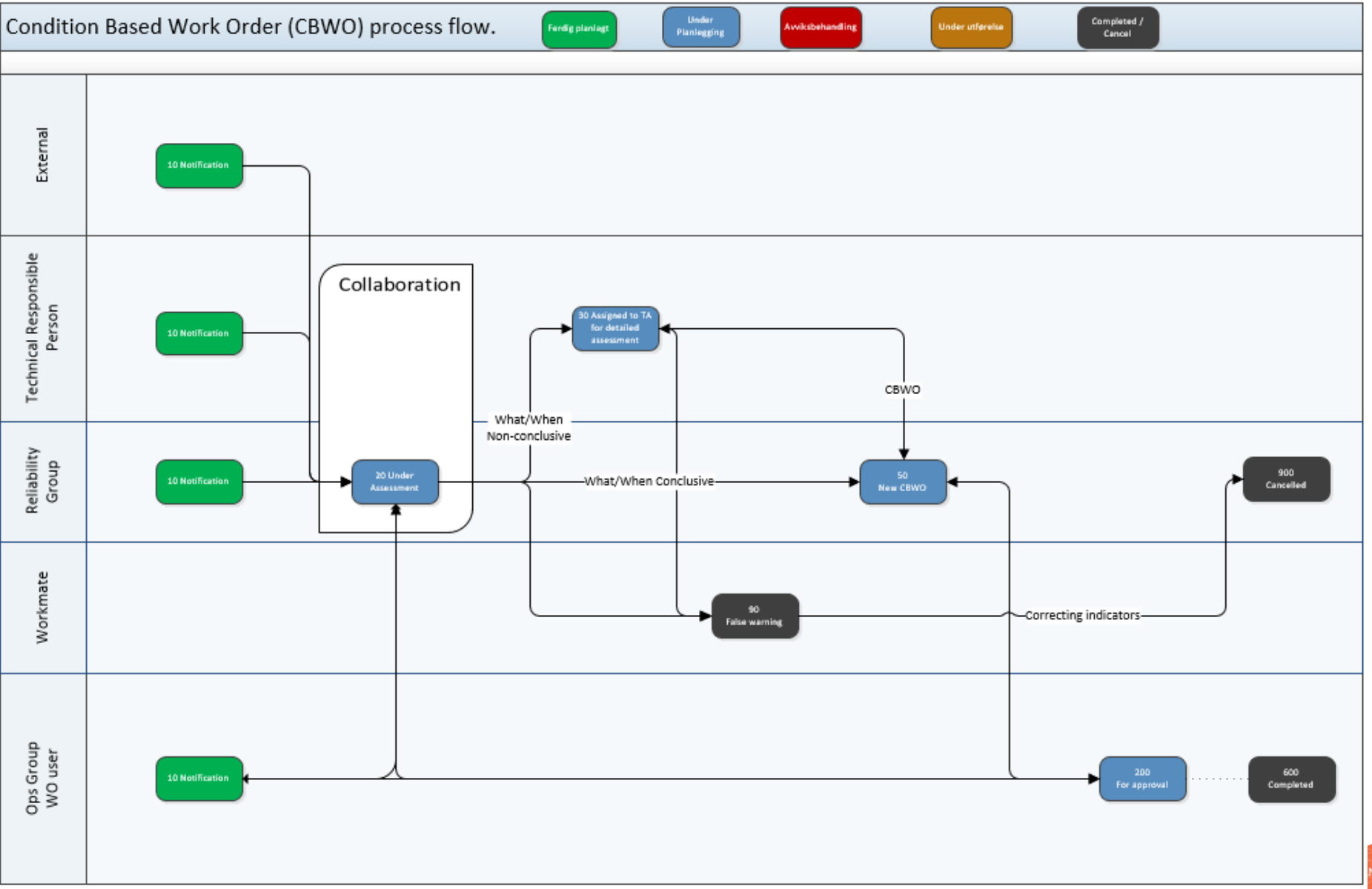
ABB Asset Optimizer

Electrical Switchgear


http://sentinel.lnas.no/MES/Default.aspx#/UAS/UASLandingPage
Honeywell Intuition - UAS ...
Honeywell | Asset Sentinel
CONTENTS
Dashboards
Asset Status
Performance Overview
Event Management
Monitor
Investigate
History
Detail Views
Fault Tree
Asset Details
Asset Trend
Asset Attributes
Manual Data Entry
Calculation Status
Datasource Status
Reports
Configuration
Assets
Calculations
Templates
Datasources
Workspaces
Information — 20ESV1048
Maintenance
Ytterligere informasjon
ASSETS
PlantHierarchy
Edvard Grieg
13 Stigerør og brønnsyster
20 Separasjon og stabilise
20 HART Instrumenter
20 Kontrollventiler
20 ON OFF Safety Valve
20ESV1043
20ESV1045
20ESV1048
20ESV1143
20ESV1145
20ESV1148
20ESV1243
20ESV1245
20ESV1343
20ESV1351
20ESV1443
20ESV1445
20XSV1042
20XSV1142
20XSV1213
20XSV1242
20XSV1342
20XSV1440
20 Transmitter deviation
20HA001
20HA002
21 Råoljehåndtering og må
23 Gasskompresjon
24 Gasstørking
26 Gassinjeksjon
27 Gasseksport
29 Vanninjeksjon
34 Vanninjeksjonsrørlednir
40 Kjølemedium
41 Varmemedium
42 Kjemikalieinjeksjon
43 Fakkel
44 Produsert vann
45 Brenngass
Fault Tree | 20ESV1048
20ESV1048
Belastnings varianse for liten
Lukke moment/kraft overskredet
Tid for å lukke overskredet
Tid for å åpne overskredet
Time Closing Warning
Time Opening Warning
Ventil lekasje
Åpne moment/kraft overskredet
16:22
28/10/2019

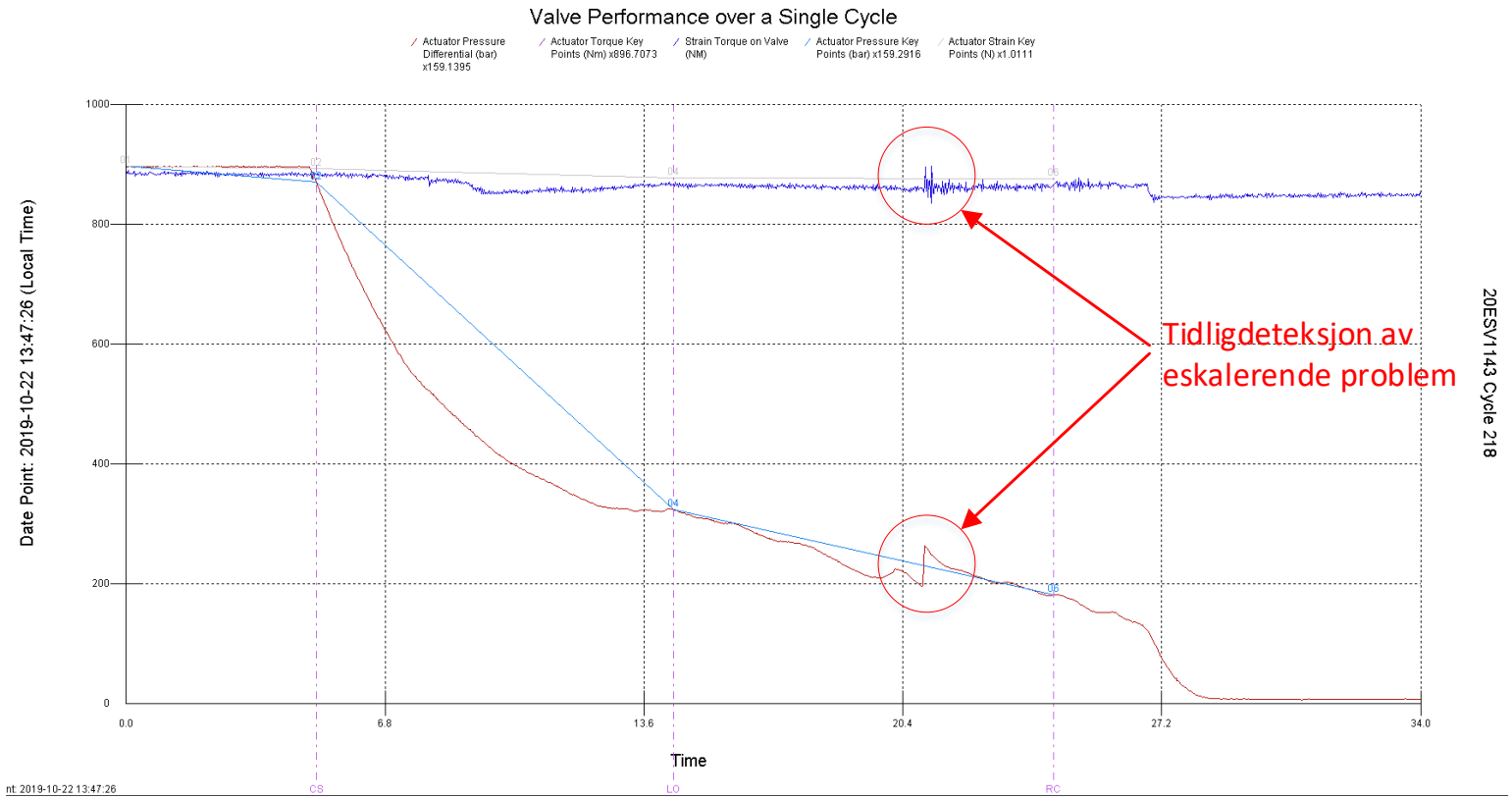
Conceptual CBM process




Condition Based Work Order (CBWO) process flow.
Ferdig planlagt
Under Planlegging
Avviksbehandling
Under utførelse
Completed / Cancel
External
Technical Responsible Person
Reliability Group
Workmate
Ops Group WO user
10 Notification
10 Notification
10 Notification
10 Notification
Collaboration
20 Under Assessment
30 Assigned to TA for detailed assessment
What/When Non-conclusive
What/When Conclusive
CBWO
50 New CBWO
90 False warning
900 Cancelled
Correcting indicators
200 For approval
600 Completed

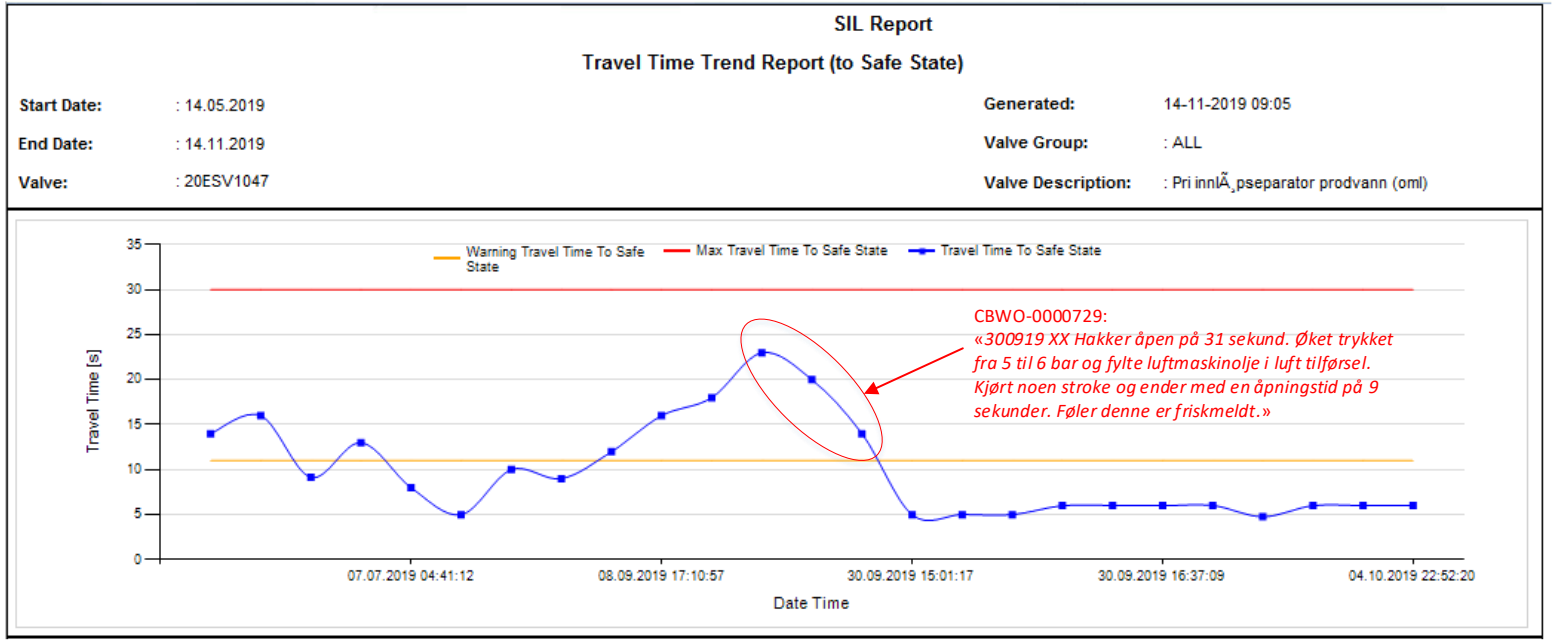
Goal for follow-up of SIL in operations

- Restore functionality before failure escalation



Goal for follow-up of SIL in operations

- Restore functionality before failure escalation



- Failure fixed =>«as good as new». What was root cause? Failure mode: «Other»…
- We have to become better at learning of failures. Maintenance personnel must be involved while the problem is active, and make sure observations are documented in a format and level of detail which enables analysis and learning.


23
Lundin
Energy Norway
23
Thank you for your attention!