

# PETRO 2020



**SATODEV**

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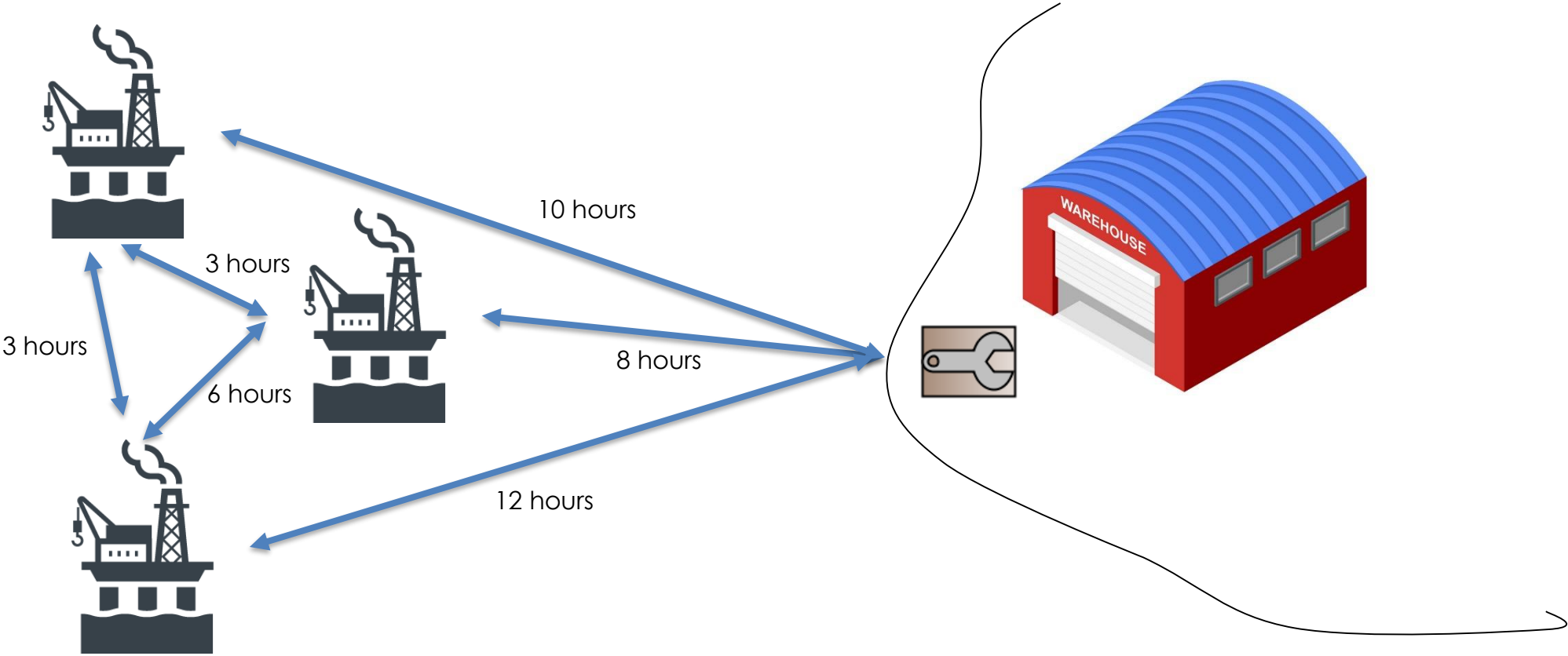
SAFETY TOOLS DEVELOPMENT

# CONTENTS

- Geographical areas
- Mobilizable teams
- New cost and more detailed cost results
- Component Restart
- CCF with Standby
- Timeline for contribution
- New comparison for results
- New preventive maintenance GUI
- PM schedule
- New ageing features (CCF, component)
- Stock replenished from another stock
- Opportunistic maintenance for degraded failure



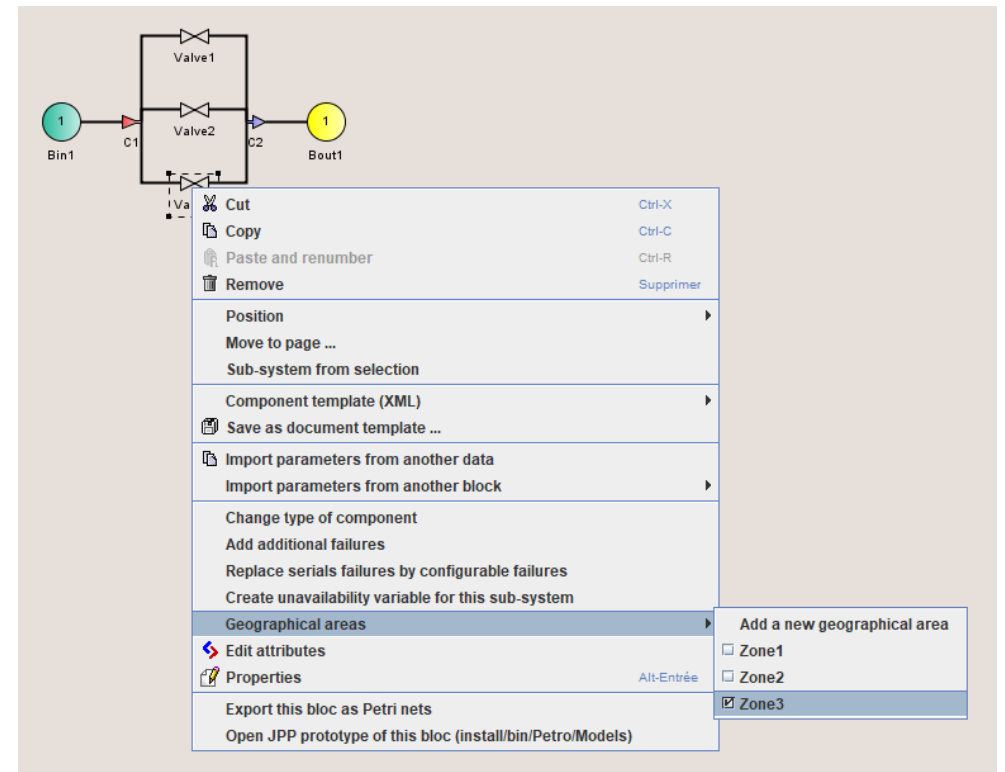
# GEOGRAPHICAL AREAS



# GEOGRAPHICAL AREA

- New type of data: (see demo)
  - Creation in data table
  - Possible use in contextual menu

Name ▲	Description	Linked data	Défaut area
Zone1	The first platform	Valve1	<input checked="" type="checkbox"/>
Zone2	The second one	Valve2	<input type="checkbox"/>
Zone3	Another site	Valve3	<input type="checkbox"/>



# GEOGRAPHICAL AREA

- Team mobilization
  - Time between areas
  - Time in one zone (to go to the next component in the same area)

Properties of 'Maintenance crew' - MaintenanceCrew1

Number: 1

Name ( ☒ Automatic ): MaintenanceCrew1

Number of maintenance crews: 1

**Mobilization time** | Working hours | Condition of mobilization

☐ Without mobilisation time

☐ With mobilisation time

Mobilization time (h): 48.0

Repair after Xth failure: 1

☒ With consideration of geographical areas

Repair after Xth failure: 1

Time of mobilization between each zone (h):

From \ To	Warehouse	Zone1	Zone2	Zone3
Warehouse	-	10	8	12
Zone1	10	0.5	3	3
Zone2	8	3	0.5	6
Zone3	12	3	6	0.5

OK Cancel Help



# MOBILIZABLE TEAMS

- V2019 : Teams are always mobilizable (with a delay)
- V2020 : Teams are not always mobilizable (specific condition or schedule) :
  - A RIG available 4 months/year
  - A maintenance team can't access Arctic area from December to February
  - Helicopters are unavailable for 2 days if there is a storm ...

Properties of 'Maintenance crew' - MaintenanceCrew1

Number: 1

Name ( ☒ Automatic ): MaintenanceCrew1

Number of maintenance crews: 1

**Mobilization time** | Working hours | **Condition of mobilization**

☐ Always mobilizable

☒ Mobilizable according to schedule New schedule (see preventive maintenance)

Periodic configuration | Detailed configuration

1 hidden columns

Name	t0 (h)	Length (h)	Period (h)	Repeat
RIG Available	2190.0	5840.0	8760.0	during the entire o...

☐ Mobilizable according to condition

Relationships on conditions: ☒ and ☐ or ☐ manual

Add a criteria:

OK Cancel Help



# COST MANAGEMENT IMPROVEMENT

- One hourly cost for each state of the team :
  - Repairing
  - During Mobilization
  - Nothing but mobilizable
  - Not mobilizable = 0

Properties of 'Maintenance crew' - MaintenanceCrew1

Number: 1

Name ( ☒ Automatic ): MaintenanceCrew1

Number of maintenance crews: 1

Hourly cost during repair: 150 \$ / h

Hourly cost in the waiting phase: 5 \$ / h

**Mobilization time** | Working hours | Condition of mobilization

☐ Without mobilisation time

☐ With mobilisation time

Mobilization time (h): 48.0

Repair after Xth failure: 1

Mobilization cost: 0 \$

Hourly cost in mobilization phase: 0 \$ / h

☒ With consideration of geographical areas

Repair after Xth failure: 1

Mobilization cost: 2350 \$

Hourly cost in mobilization phase: 50 \$ / h

Time of mobilization between each zone (h) :

From \ To	Warehouse	Zone1	Zone2	Zone3
Warehouse	-	10	8	12
Zone1	10	0.5	3	3
Zone2	8	3	0.5	6
Zone3	12	3	6	0.5

OK Cancel Help



# COST MANAGEMENT IMPROVEMENT

- Specific cost for degraded failure

The screenshot shows a software window titled 'Properties of Equipments' - CentrifugalCompressor1. It has four tabs: 'Description', 'Start-up phase', 'Critical failures', and 'Degraded failure'. The 'Degraded failure' tab is active. It contains several input fields and checkboxes. The 'Cost' field, located at the bottom of the main input area, is highlighted with a red oval. Below the main input area is a section for 'Condition to repair' with radio buttons for 'and', 'or', and 'manual', and an 'Add a criteria' button. At the bottom of the window are 'OK', 'Cancel', and 'Help' buttons.



Field	Value
Degraded capacity (outflow)	70.0 % of nominal capacity
<input type="checkbox"/> Apply a degraded capacity during repairs	
<input type="checkbox"/> Repair degraded failures during preventive maintenances occasions	
LambdaD ( $\lambda$ in $h^{-1}$ )	1E-6
Coefficient DC	1.0
MTTR (h)	36
Maintenance crew	
Spare parts	
<b>Cost</b>	1500000 \$





# COST MANAGEMENT IMPROVEMENT

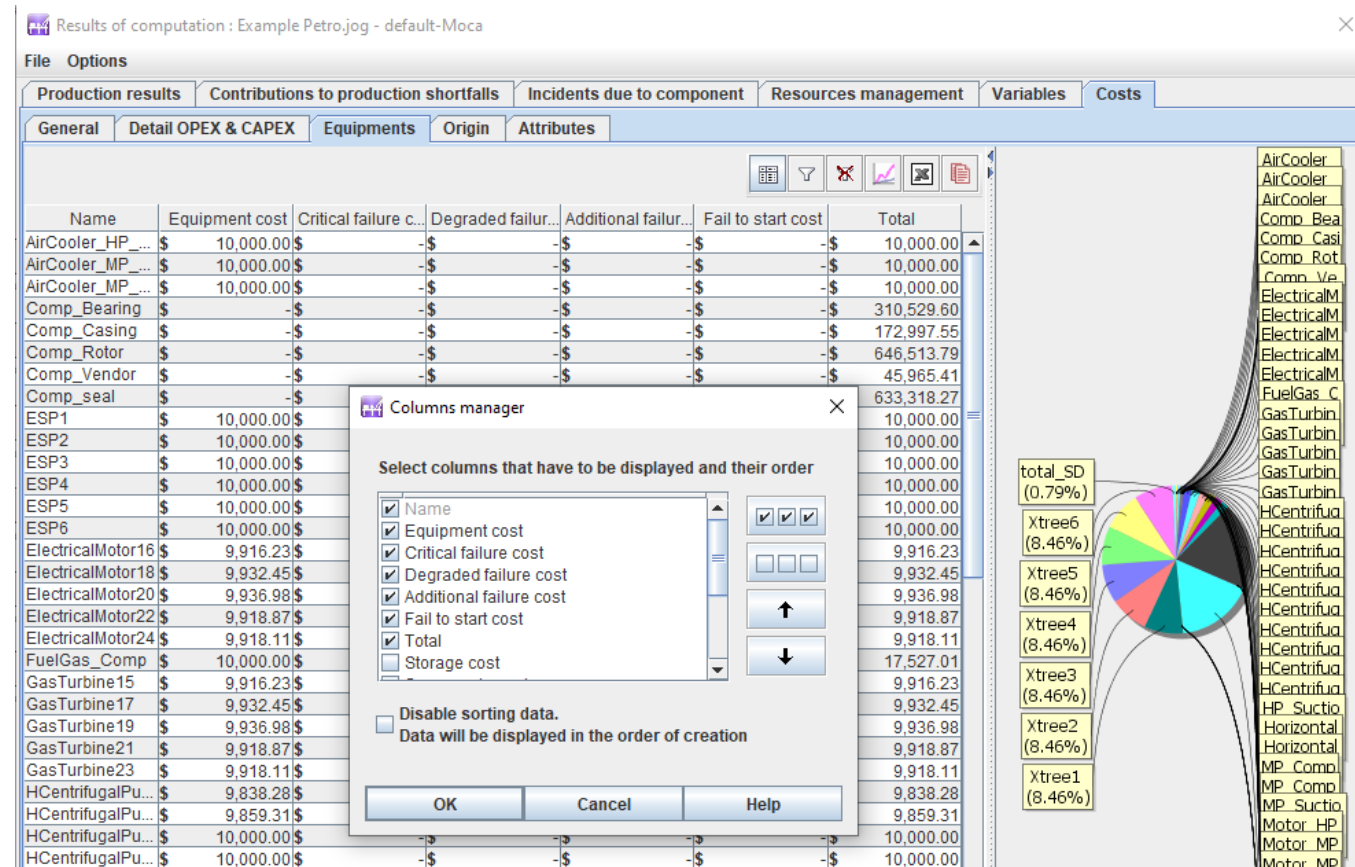
- Specific cost for start-up failure

Start-up failure	
Fail to start probability (y)	0.0
Delay before fail to start	0.5
MTTR (h)	100
Maintenance crew	<input type="text"/> ▼ 
Spare parts	<input type="text"/> ▼ 
Cost	0.0 \$



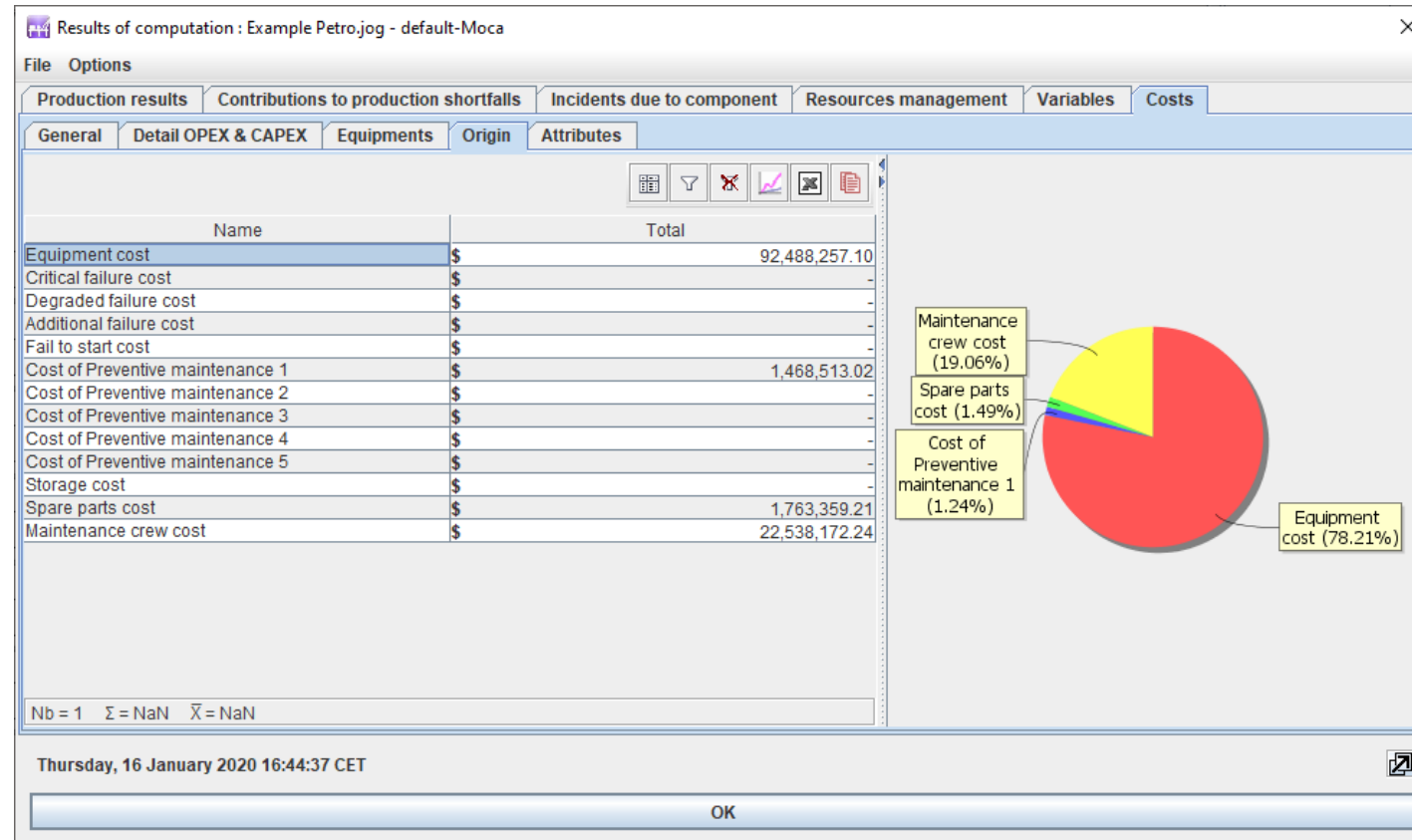
# COST MANAGEMENT IMPROVEMENT

## Detailed results by equipment



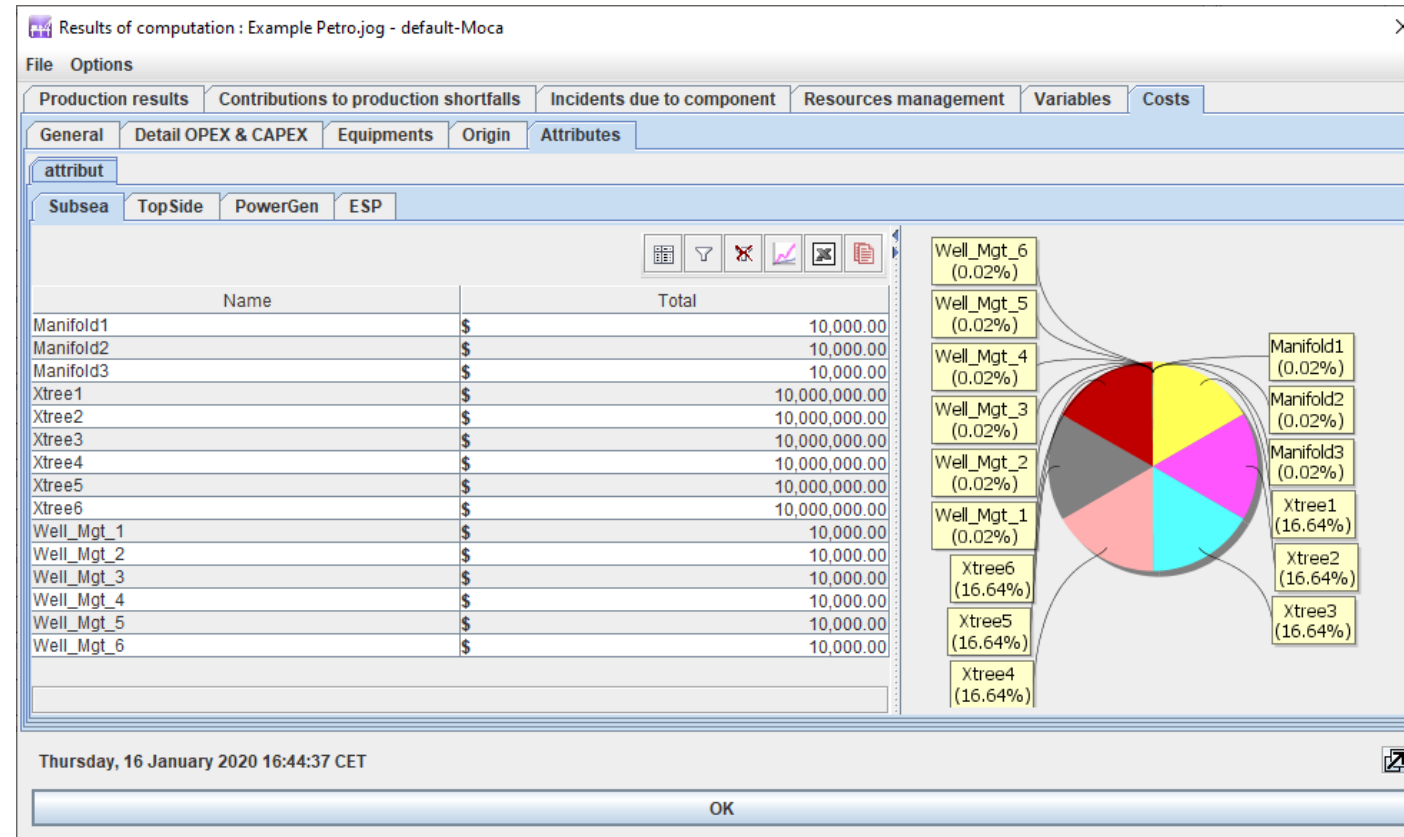
# COST MANAGEMENT IMPROVEMENT

## By origin



# COST MANAGEMENT IMPROVEMENT

## ● By attributes



# COMPONENT RESTART

## ● Restart then Start-up

Properties of 'Equipments' - HCentrifugalPump1

Description Start-up phase Critical failures

Restart / Start-up configuration

☒ Restart-delay

Restart-delay 60

Restart-capacity 20 % of nominal capacity

☒ Start-up

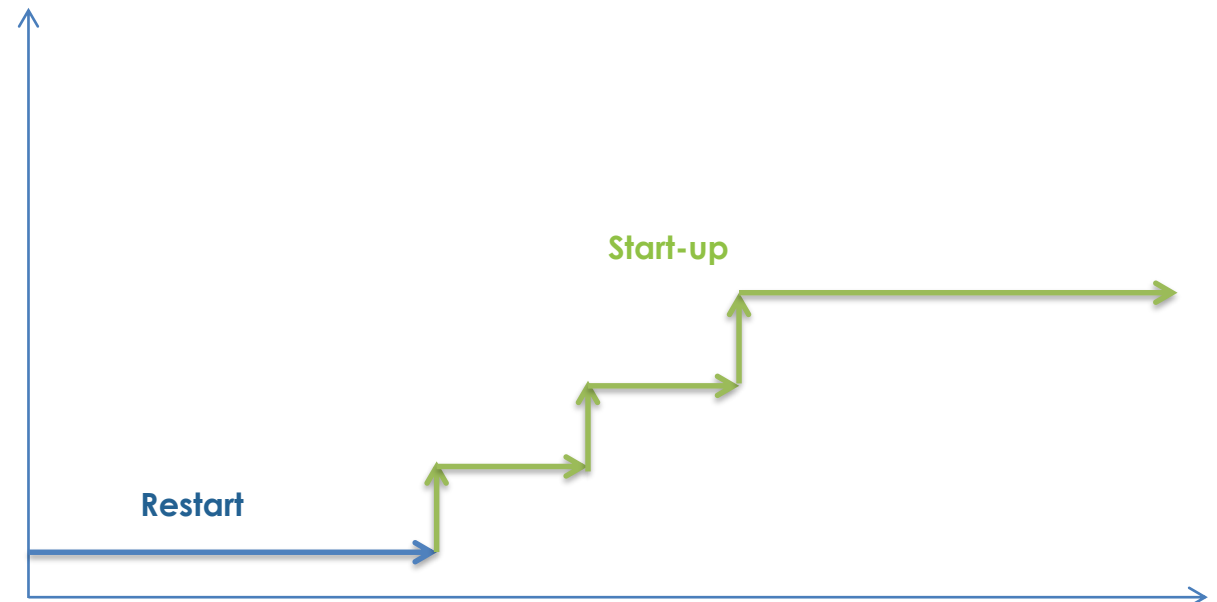
Start-up time from 0% to 100% capacity (h) 10

Number of steps before starting full 2.0

Delay before restart and start-up (h) 12

Start-up priority 0.0

☐ Equiprobable start-up transitions



## CCF WITH STAND-BY

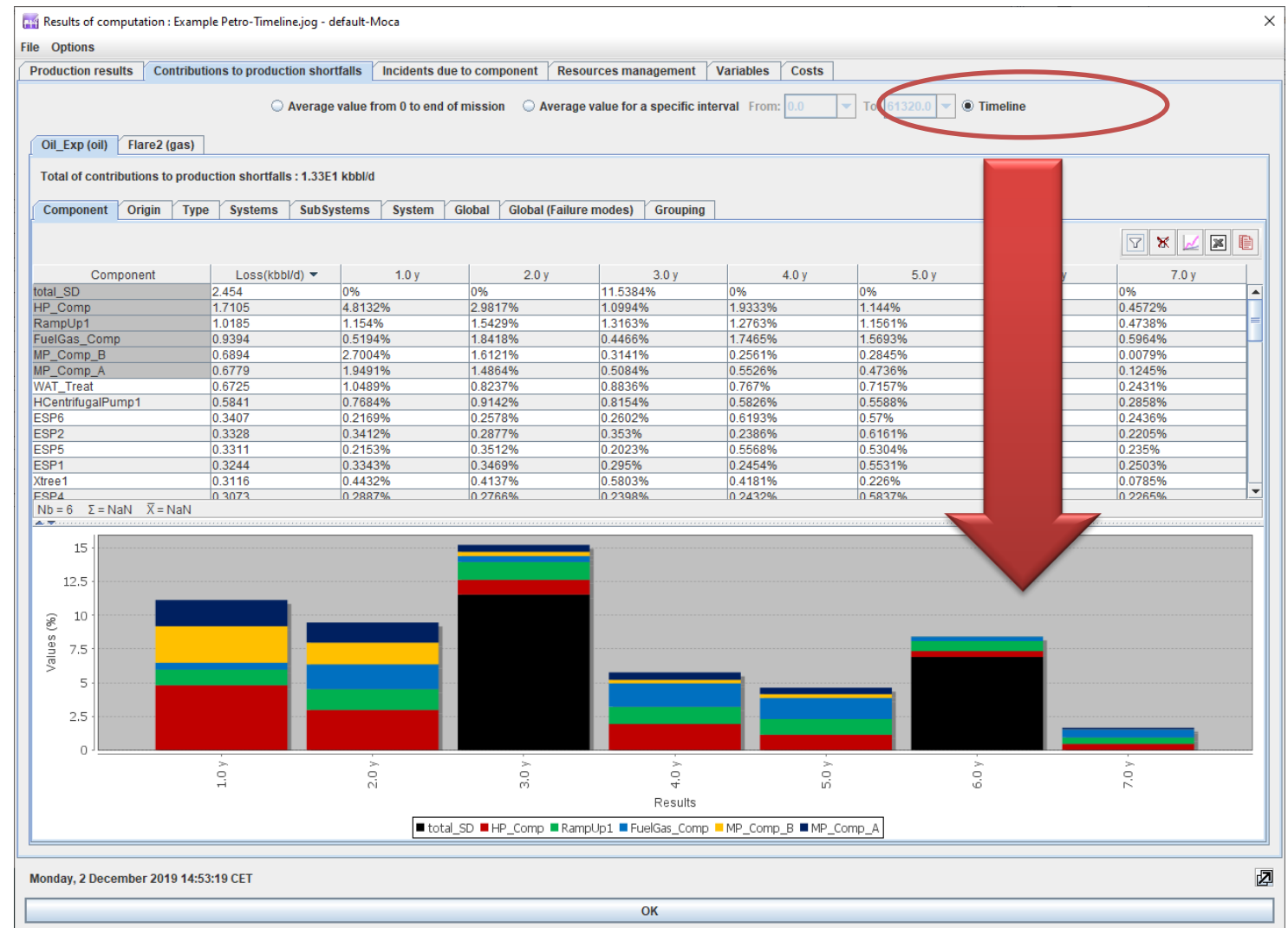
- CCF of critical failure was impossible in Stand-by
- Now users can choose

The screenshot shows a software window titled 'Properties of Equipments' - HCentrifugalPump2. It has several tabs: 'Description', 'Start-up phase', 'Additional failures', 'Critical failures', and 'CCF'. The 'CCF' tab is selected. Inside the 'CCF' tab, there are several input fields: 'CCF' (set to 'ccf1'), 'Maintenance crew', 'Spare parts', and 'MTTR (h)' (set to '400'). Below these fields is a checkbox labeled 'May occur even if the component is in stand-by', which is currently unchecked. This checkbox is circled in red. At the bottom of the window are 'OK', 'Cancel', and 'Help' buttons.



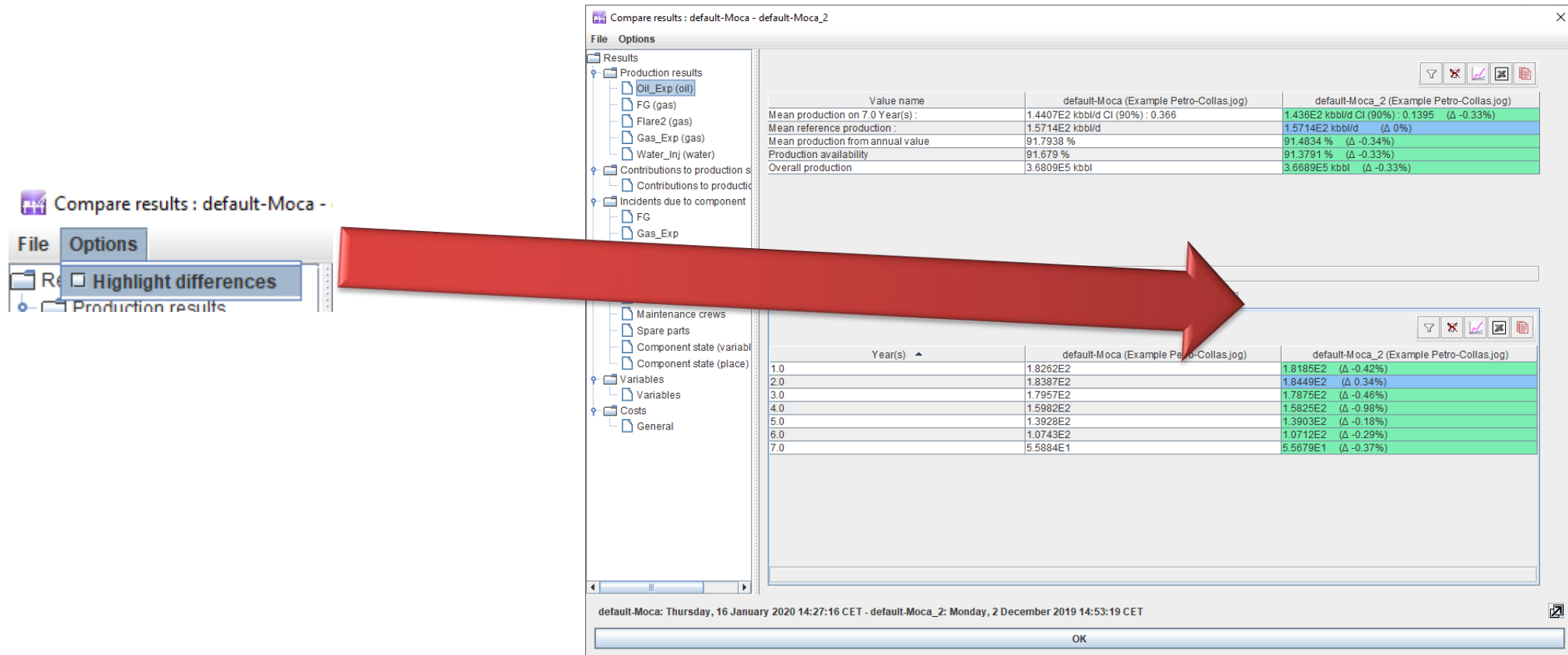
# TIME LINE FOR CONTRIBUTION

- Main contributors of first years are not the same as main contributors of last years. TimeLine option give the detail.  
(See Demo)



# NEW RESULT COMPARISON

## ● Difference Highlighting (See Demo)



The screenshot shows the 'Compare results' dialog box with the 'Options' tab selected. The 'Highlight differences' checkbox is checked. A red arrow points from this checkbox to the comparison tables.

**Comparison Table 1: default-Moca vs default-Moca\_2**

Value name	default-Moca (Example Petro-Collas.jog)	default-Moca_2 (Example Petro-Collas.jog)
Mean production on 7.0 Year(s) :	1.4407E2 kbb/d CI (90%) : 0.366	1.436E2 kbb/d CI (90%) : 0.1395 (Δ -0.33%)
Mean reference production :	1.5714E2 kbb/d	1.5714E2 kbb/d (Δ 0%)
Mean production from annual value	91.7938 %	91.4834 % (Δ -0.34%)
Production availability	91.679 %	91.3791 % (Δ -0.33%)
Overall production	3.6809E5 kbb/d	3.6689E5 kbb/d (Δ -0.33%)

**Comparison Table 2: Year(s) vs default-Moca vs default-Moca\_2**

Year(s)	default-Moca (Example Petro-Collas.jog)	default-Moca_2 (Example Petro-Collas.jog)
1.0	1.8262E2	1.8185E2 (Δ -0.42%)
2.0	1.8387E2	1.8449E2 (Δ 0.34%)
3.0	1.7957E2	1.7875E2 (Δ -0.46%)
4.0	1.5982E2	1.5825E2 (Δ -0.98%)
5.0	1.3928E2	1.3903E2 (Δ -0.18%)
6.0	1.0743E2	1.0712E2 (Δ -0.29%)
7.0	5.5884E1	5.5679E1 (Δ -0.37%)

default-Moca: Thursday, 16 January 2020 14:27:16 CET - default-Moca\_2: Monday, 2 December 2019 14:53:19 CET

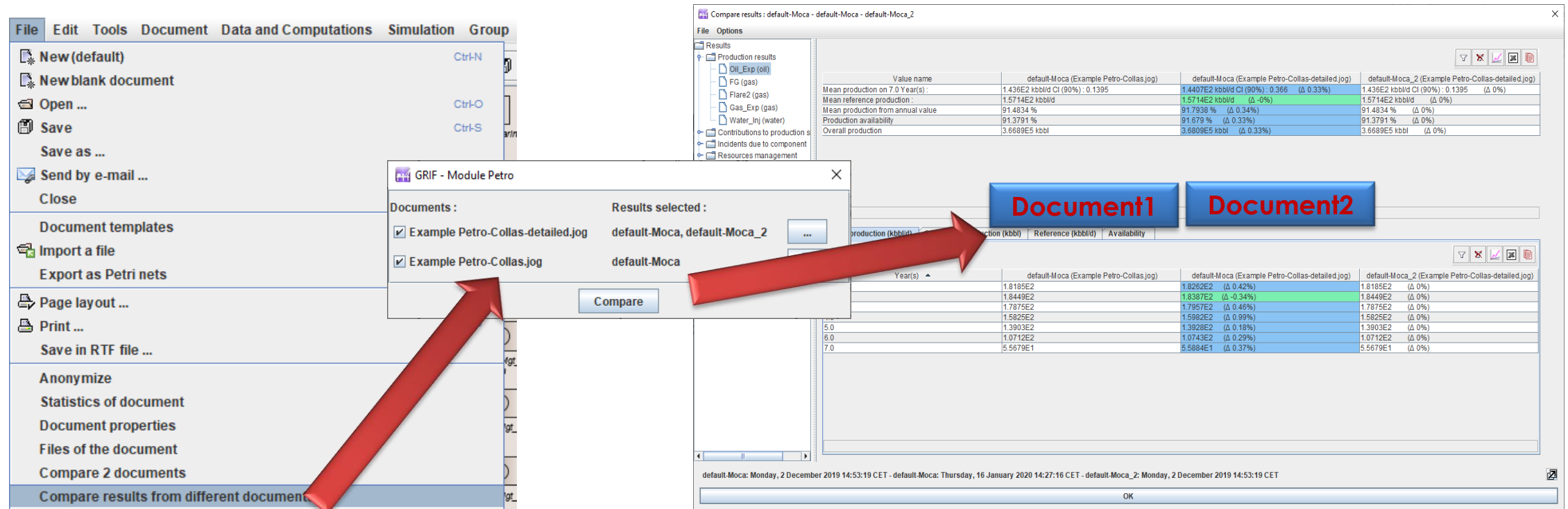
OK





# NEW RESULT COMPARISON

- Result comparison between documents



**Compare results: default-Moca - default-Moca - default-Moca\_2**

Value name	default-Moca (Example Petro-Collas.jog)	default-Moca (Example Petro-Collas-detailed.jog)	default-Moca_2 (Example Petro-Collas-detailed.jog)
Mean production on 7.0 Year(s) :	1.436E2 kbbld CI (90%) : 0.1395	1.4407E2 kbbld CI (90%) : 0.366 (Δ 0.33%)	1.436E2 kbbld CI (90%) : 0.1395 (Δ 0%)
Mean reference production :	1.5714E2 kbbld	1.5714E2 kbbld (Δ -0%)	1.5714E2 kbbld (Δ 0%)
Mean production from annual value	91.4834 %	91.7938 % (Δ 0.34%)	91.4834 % (Δ 0%)
Production availability	91.3791 %	91.679 % (Δ 0.33%)	91.3791 % (Δ 0%)
Overall production	3.6689E5 kbbld	3.6809E5 kbbld (Δ 0.33%)	3.6689E5 kbbld (Δ 0%)

**GRIF - Module Petro**

Documents :

- ☒ Example Petro-Collas-detailed.jog
- ☒ Example Petro-Collas.jog

Results selected :

- default-Moca, default-Moca\_2
- default-Moca

**Compare**

**Document1** **Document2**

Year(s)	default-Moca (Example Petro-Collas.jog)	default-Moca (Example Petro-Collas-detailed.jog)	default-Moca_2 (Example Petro-Collas-detailed.jog)
1.8185E2	1.8262E2 (Δ 0.42%)	1.8185E2 (Δ 0%)	
1.8449E2	1.8387E2 (Δ -0.34%)	1.8449E2 (Δ 0%)	
1.7875E2	1.7957E2 (Δ 0.46%)	1.7875E2 (Δ 0%)	
1.5825E2	1.5982E2 (Δ 0.99%)	1.5825E2 (Δ 0%)	
1.3903E2	1.3928E2 (Δ 0.18%)	1.3903E2 (Δ 0%)	
1.0712E2	1.0743E2 (Δ 0.29%)	1.0712E2 (Δ 0%)	
5.679E1	5.6884E1 (Δ 0.37%)	5.679E1 (Δ 0%)	

default-Moca: Monday, 2 December 2019 14:53:19 CET - default-Moca: Thursday, 16 January 2020 14:27:16 CET - default-Moca\_2: Monday, 2 December 2019 14:53:19 CET

OK



# NEW PREVENTIVE MAINTENANCE GUI

- Two input modes:
  - True periodical maintenances (See Demo)
  - Detailed list of maintenances (V2019)

Properties of 'Equipments' - HorizontalVessel10

Description Start-up phase Critical failures Maintenance periods

Periodic maintenances Detailed maintenances

Conflict management

Merge mode : Hidden

Type of maintenance to keep : Maximal

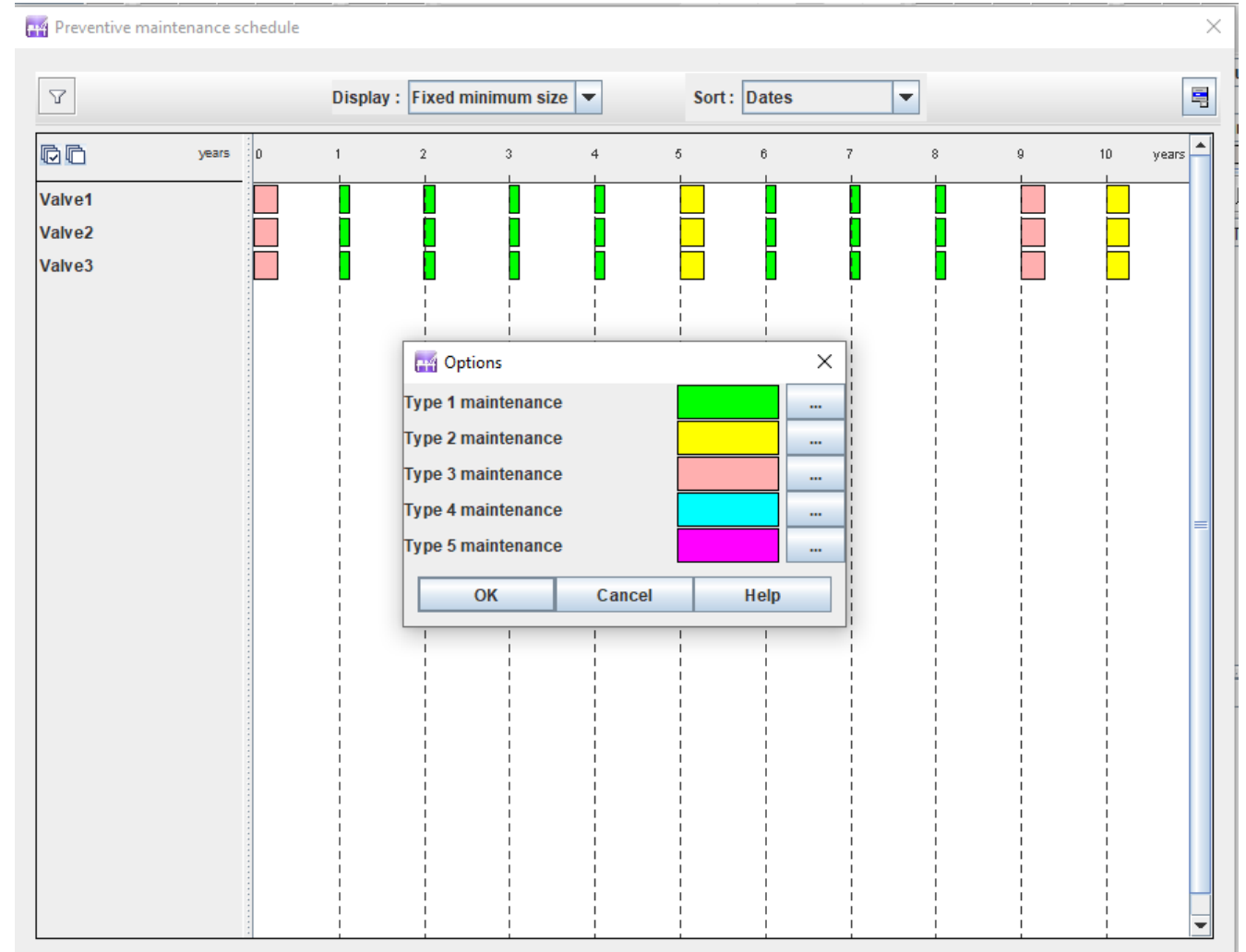
1 hidden columns

Name	t0 (h)	Length (h)	Maintenance ...	Cost (\$)	Period (h)	Repeat	Mode	Efficiency model	Maintenance eff...
toto	0.0	10.0	Type 1	0.0	8760.0	10 times	Calendar times	Brown-Proscha...	1.0



# PM SCHEDULE

## Colored schedule:



## NEW AGEING FEATURES

- V2019 : Brown-Proschan (BP) ageing
  - With a probability that the preventive maintenance repairs (AGAN) the component
  - Correspond to “probability that failure is detected and fully repair, and if it isn’t nothing is done”
  - Can’t handle the “age reducing” in one history (even if results are equivalent with o lot of histories)



# NEW AGEING FEATURES

- V2020 : BP or  $ARA_{\infty}$
- $ARA_{\infty}$  = there is always an effective maintenance, but never AGAN, age is only reduced.
- Available for curative and preventive maintenance and CCF

Properties of 'Equipments' - HorizontalVessel10

Description Start-up phase Critical failures

Eta ( $\eta$  in h) 1000 MTTR (h) 48

Beta ( $\beta$ ) 1.5 Maintenance efficiency 0.9

Efficiency model **Brown-Proschan (BP)**

Other components in series

Component	$\lambda$ ( $h^{-1}$ )	MTTR (h)	Qty

Properties of 'CCF' - ccf1

Number 1

Name (Automatic) ccf1

Description

☒ With ageing

Eta ( $\eta$  in h) 1000

Beta ( $\beta$ ) 1

☒ Efficiency specific to CCF

Efficiency model  $ARA_{\infty}$

Maintenance efficiency 1

OK Cancel Help

Properties

Name toto

t0 0.0 Hour(s)

Length 10.0 Hour(s)

☒ Calendar times ☐ Operational times

Maintenance type Type 1

Ageing component

Efficiency model **Brown-Proschan (BP)**

Maintenance efficiency 1.0

Maintenance cost 0.0 \$

Description

Periodic

Every 1.0 Year(s)

☐ Repeat until t= Year(s)

☒ Repeat 10 times

☐ Repeat until the end of operation

OK Cancel Help

# STOCK REPLENISHED FROM ANOTHER STOCK

- Local stock + regional stock + worldwide stock ?  
– (See Demo)

The screenshot shows a dialog box titled "Properties of 'Spare parts' - Comp\_Bearing". It contains several input fields and radio buttons. The "Replenishment from another stock" option is selected and circled in red. The "Spare parts" dropdown menu is set to "Comp\_Bearing\_Worldwide".

Field	Value
Number	4
Name ( <input type="checkbox"/> Automatic )	Comp_Bearing
Initial number of spares	5
Unit cost	100000 \$
Storage cost	0 \$ h <sup>-1</sup>
<input type="radio"/> Without replenishment	
<input type="radio"/> Replenished on demand	
Procurement threshold	0
Procurement time (h)	2160
<input type="radio"/> Periodic replenishment	
Procurement period (h)	8760.0
First procurement (h)	8760.0
<input checked="" type="radio"/> Replenishment from another stock	
Procurement threshold	2
Procurement time (h)	72
Spare parts	Comp_Bearing_Worldwide



# OPPORTUNISTIC MAINTENANCE

Properties of 'Equipments' - Well\_Mgt\_1

Description Start-up phase SIMOPs Additional failures Degraded failure

Degraded capacity (outflow) 70.0 % of nominal capacity

☐ Apply a degraded capacity during repairs

☐ Repair degraded failures during preventive maintenances occasions

LambdaD ( $\lambda$  in  $h^{-1}$ ) 1E-3

Coefficient DC 1.0

MTTR (h) 10

Maintenance crew

Spare parts

Cost 0.0 \$



# THE END 😊



# SATODEV

SAFETY TOOLS DEVELOPMENT