

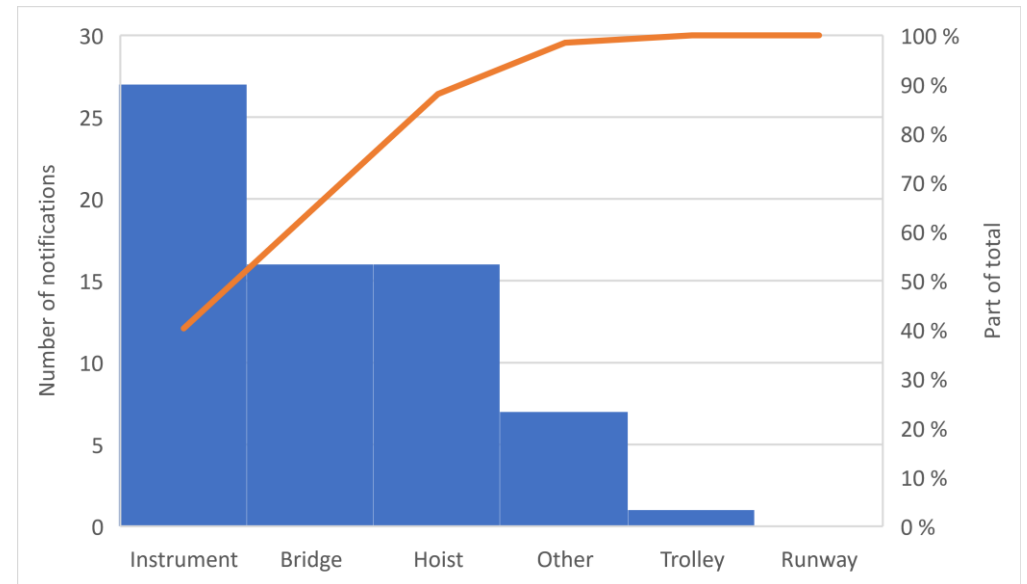
Complete Analysis

TAG NO. 07010

1-1 Pareto pre-modifications

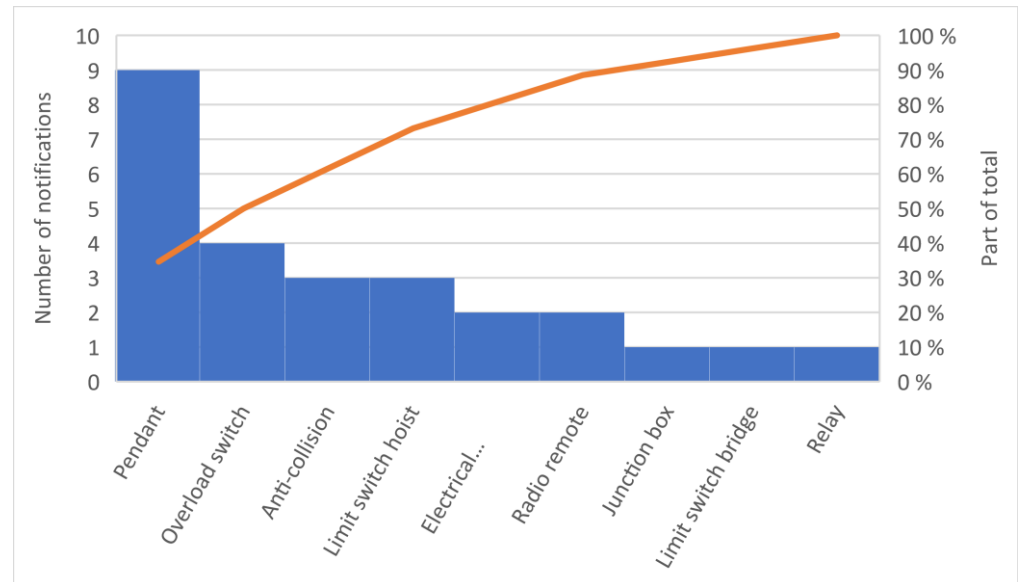
Overall

Instrument	27	0,402985
Bridge	16	0,238806
Hoist	16	0,238806
Other	7	0,104478
Trolley	1	0,014925
Runway	0	0
Totalt minus kanselleter	67	
Kansellert	14	
Totalt	81	
Optelling fra Notifikasjoner	81	



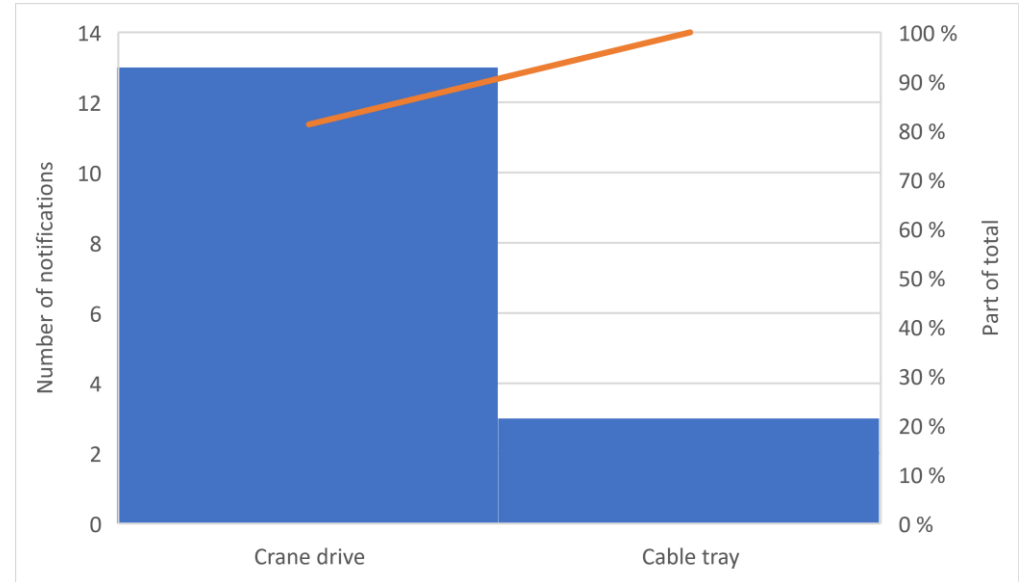
Instrument

Pendant	9	0,346154
Overload switch	4	0,153846
Anti-collision	3	0,115385
Limit switch hoist	3	0,115385
Electrical protection devices	2	0,076923
Radio remote	2	0,076923
Junction box	1	0,038462
Limit switch bridge	1	0,038462
Relay	1	0,038462



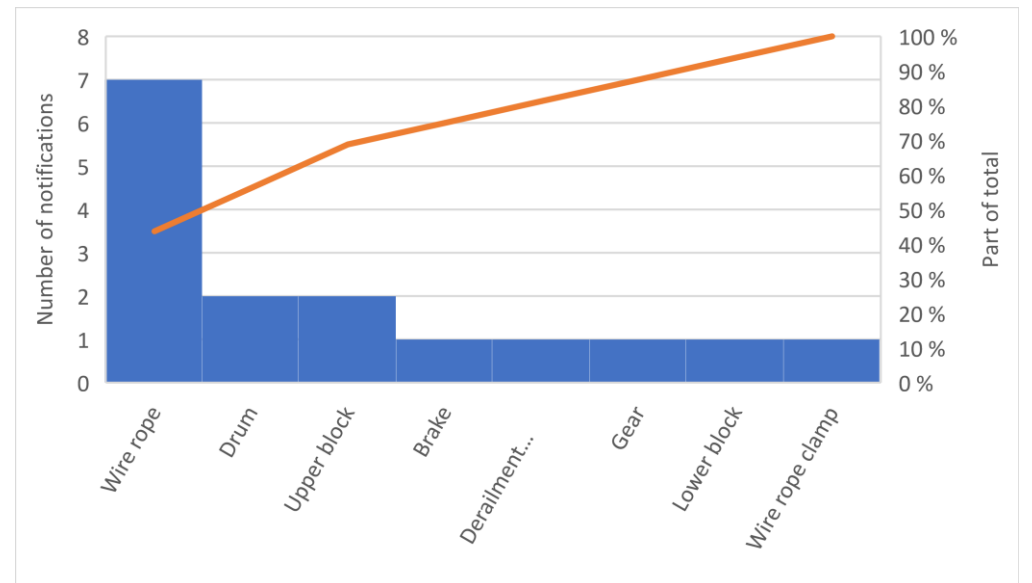
Bridge

Cable tray	3	0,1875
Crane drive	13	0,8125



Hoist

Brake	1	0,0625
Derailment protection	1	0,0625
Drum	2	0,125
Gear	1	0,0625
Lower block	1	0,0625
Upper block	2	0,125
Wire rope	7	0,4375
Wire rope clamp	1	0,0625



Prioritering

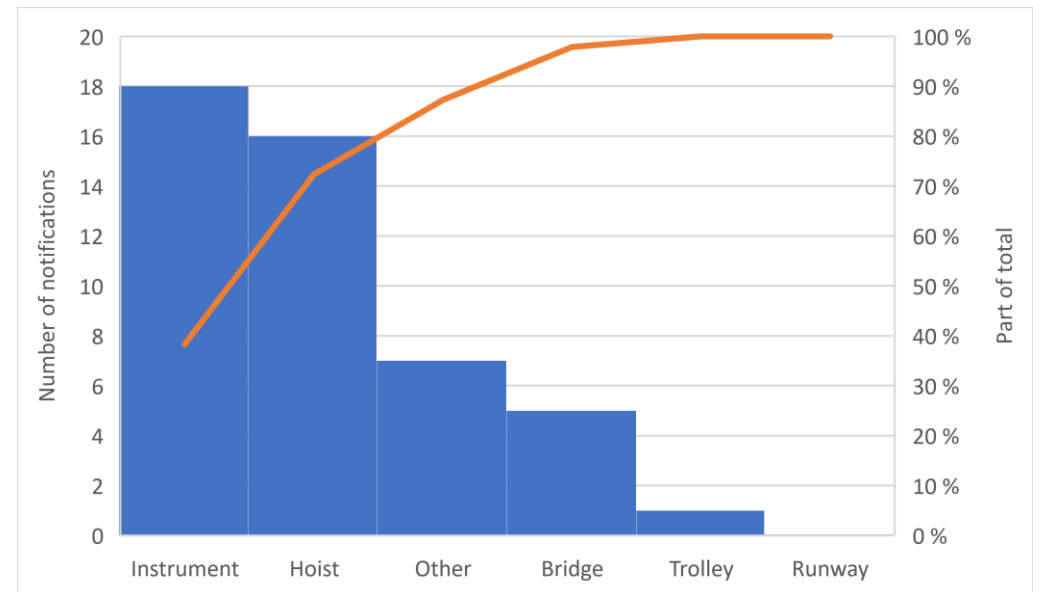
	67	
Priority E	15	0,223881
Priority 1	32	0,477612
Priority 2	17	0,253731
Priority 3	3	0,044776



1 - 2 Pareto after modification

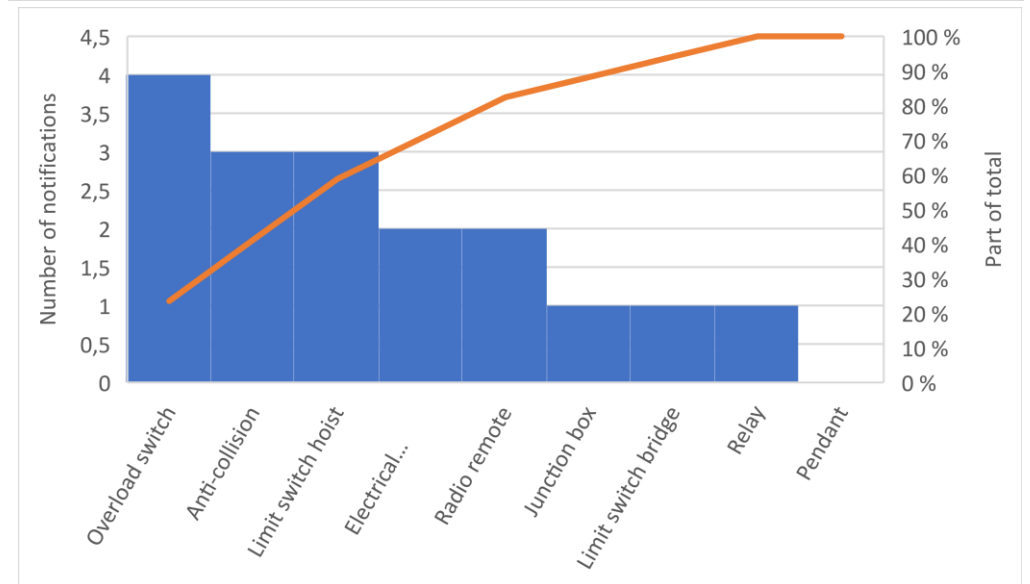
Overall

Instrument	18	0,382979
Bridge	5	0,106383
Hoist	16	0,340426
Other	7	0,148936
Trolley	1	0,021277
Runway	0	0
Totalt minus kanselleter	47	



Instrument

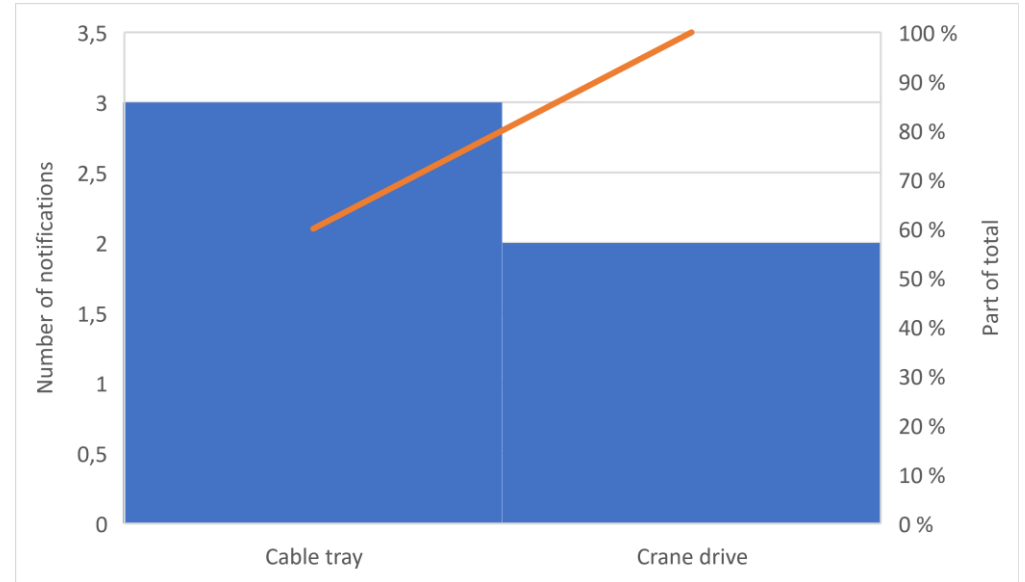
Instrument	17	
Pendant	0	0
Overload switch	4	0,235294
Anti-collision	3	0,176471
Limit switch hoist	3	0,176471
Electrical protection devices	2	0,117647
Radio remote	2	0,117647
Junction box	1	0,058824
Limit switch bridge	1	0,058824
Relay	1	0,058824



Bridge

Cable tray	3	0,6
Crane drive	2	0,4

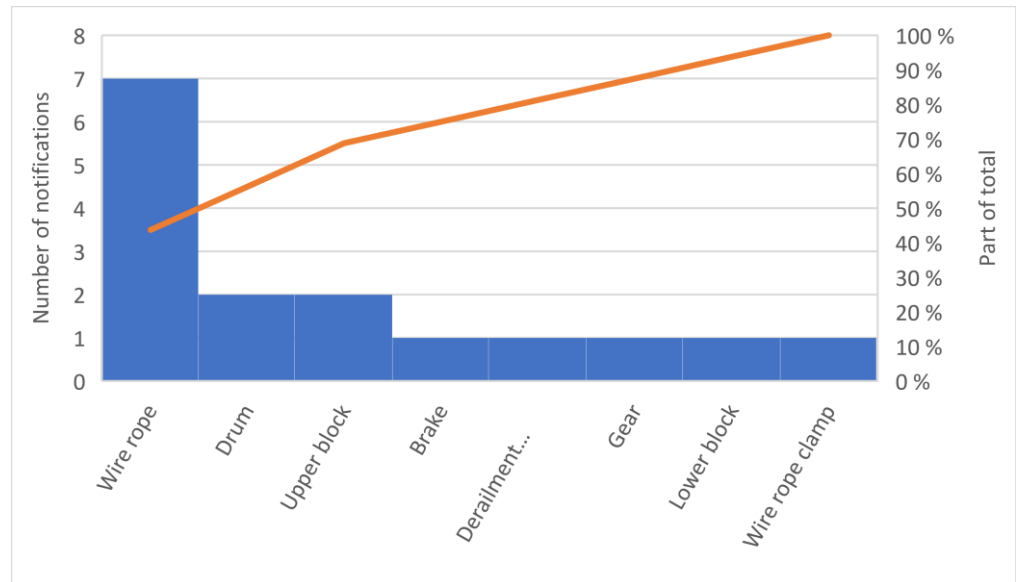
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Hoist

Brake	1	0,0625
Derailment protection	1	0,0625
Drum	2	0,125
Gear	1	0,0625
Lower block	1	0,0625
Upper block	2	0,125
Wire rope	7	0,4375
Wire rope clamp	1	0,0625

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RCM – Systems analysis

Step 2-1:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Overview	System ID:	BD/EKOM/840/19 07010
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07010	Date:	27.03.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Major Equipment Included:

Bridge:

- Girder main assembly – P655-101
- Gearbox traveling motors E/W – KU A B0/A i=62,9 IEC AD 100
- Traveling motors E/W – HB37 100LA 4 B5 3F 690V S/60 2,2kW
- Travelling wheels – P30-122
- Cable tray arrangement – P655-104
- Drive pinions – L43-4-05 U049
- Chain RS DIN8188 Offshore – 16B-1 – 1,5m

Hoist:

- Motor hoist PB35 200L4/12 EExdeIIBT3 690/60Hz – 13kW/4,3kW-B5/B3-IP66/56
- Gear planet flange Mount B3 – Adapter for IEC 200 motor – EM1045/MR1/6,3
- Gearbox assembly – C655-10201
- Wire rope Ø18mm MBL 32,9T
- Lower block – B59-137
- Upper block – B59-139

Instrument:

- Anti-collision – E3Z
- Radio remote – HBC FST 735-09-1315-C
- Limit switches – 1S5, 1S6, 2S5, 2S6 – NCN20+U1+NO Pepperl & Fuchs
- Rotary limit switch - 3S5 – 125 BM492, B5 Stromag
- Overload switch – 3S9 – ZS 336 – 11Z Schmersal

Runway:

- Runway beams
- Runway bridge travel racks

Trolley:

- Motor travel DB35 90L4-EExdeIIBT3-B5-IP66/IP56 – 1,30kW-690V/60Hz – B5
- Gear, Angle I=99,5 – Med utg. aksel – A503 UR 99,5 P90
- Travelling pinions – L43-4-023 (U049)/(U051)
- Travelling Wheels – B30-119

Primary Physical Boundaries

Start with:

Main electrical supply 3x690V 60Hz – FROM: 28-00002-05A
Supports for runway beams

Terminate with:

Lifted load. Attached in crane hook.

Caveats:

N/A

RCM – Systems analysis

Step 2-2:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Details	System ID:	BD/EKOM/840/19 07010
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07010	Date:	27.03.2018
Subsystem:			
Analyst	Øystein Refsland Andreassen		

Type	Bounding System	Interface Location	Ref. Drawing
IN (Electrical)	Instrument	28-00002-05A	E900-11915-E-00076
IN (Structural support)	Runway	W30	E900-11915-M-0006
OUT (Load)	Hoist	W30	E900-11915-M-0006

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07010
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07010	Date:	27.03.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Functional Description/Key Parameters

The Electrical Overhead Travelling Cranes are of underslung duobox special design for Ekofisk Plattform 2/4M module W30. Both cranes are travelling on the same runway beams in north/south directions.

Main girders are made as box of plates and the end carriages are made of steel plates.

Cranes are made for Zone 1 hazardous area, All el. Equipment is designed for Zone 1 and according to DNV, NPD, ATEX and FEM rules.

The crane is for offshore installations with ambient temperature - 20°C.

Main data:

Capacity: 25T

Span: 17000 mm

Height of lift: 9,5m

Hoisting speed: 2,4 / 0,6m/min

Trolley speed: 6 m/min

Crane speed: 6 m/min

Power Supply: 690V / 60Hz

Heel: Max. 1°

Runway beams: HE550M based on max 5m between supports

Crane bridge:

The crane bridge is running on runway beams under flanges with eight (8) travel wheels. Four of these travel wheels are single flange type and mounted on one of the end carriage to obtain the horizontal travel guiding. Crane drive is equipped with explosion proof single speed electric motors with fail safe brakes through gear and pinion with cross shaft. Limit switches are installed on the crane in addition to heavy duty bumpers in each end of the runway beams. Since the two cranes are travelling on the same runway beam the cranes are equipped with anti-collision proximity switch and actuator between the two cranes in addition to bumpers. Later it was added anti-collision measures by optical sensors as well.

Hoist machinery:

Crane is equipped with electrical wire hoist with four wire falls. The hoist motor is two speed explosion proof design with fail safe brake. Overload switch and limit for top and bottom positions are included. Wire drum is grooved to ensure correct wire spooling on drum. Wire rope are galvanized and of non-rotating type.

Trolley:

The trolley is running on rails 60x60mm situated on the top of main girders with six (6) travel wheels along duo-box main girder. Trolley is also equipped with four off guide rollers against rail on top of one main girder. Trolley drive is consisting of explosion proof single speed electric motor and fail-safe brake through gear and pinions with cross shaft. Limit switches are installed on the crane bridge in addition to heavy duty bumpers in each end of the crane.

Redundancy Features

None.

Protection Features

- Limit switches bridge travel
- Anti-collision
- Overload switch

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07010
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07010	Date:	27.03.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

- Limit switch for hoist
- Limit switch for trolley
- Emergency stop
- Fail safe brakes

Key Control Features

Radio remote is utilized as main measure of control.

RCM – Systems analysis

Step 3-2:	System Description/FBD	Plant ID:	EKOM
Information:	Functional Block Diagram	System ID:	BD/EKOM/840/19 07010
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07010	Date:	27.03.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

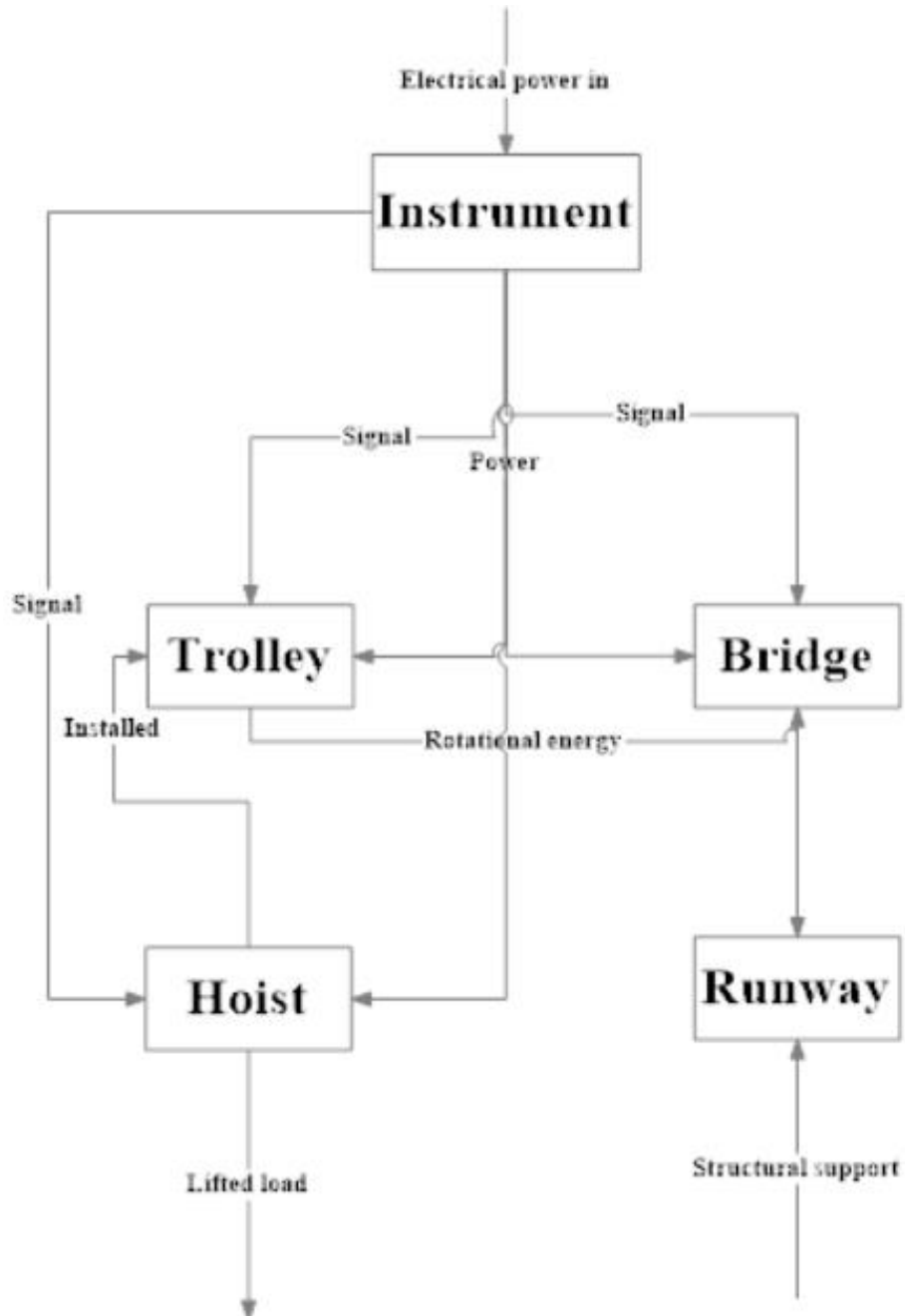


Figure 1 – Functional block diagram

RCM – Systems analysis

Step 3-3:	System Description/FBD	Plant ID:	EKOM
Information:	IN/OUT Interfaces	System ID:	BD/EKOM/840/19 07010
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07010	Date:	27.03.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Type	Bounding system	Interface location	Ref. drawing
IN (690V)	Instrument	28-00002-05A	E900-11915-E-00076
IN (Structural)	Runway	W30	E900-11915-M-0006
OUT (Energy)	Hoist	W30	E900-11915-M-0006

3-4 System Work Breakdown Structure

No #	TAG No.	Description	System	Sub-system	Type (Instrument only)	Qty	Dwg or ref
1	BD/EKOM/840/19 07010	CRANE OVERHEAD TRAVELLING 25 T NORTH	All	-		1	E900-11915-M-00006-001
2		BUMPER	Bridge	Bumper		4	E900-11915-M-00037-001
3		CABLE TRAY	Bridge	Cable tray		1	E900-11915-M-00037-001
4	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012	Bridge	Crane drive		1	EKOM-VA-E-00008-001
5	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258	Bridge	Crane drive		1	EKOM-VA-E-00008-001
6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	Bridge	Crane drive		1	EKOM-VA-E-00008-001
7	BD/EKOM/30 07258	MOTOR TRAVEL W. CRANE OVERHEAD. 19 07010	Bridge	Crane drive		1	EKOM-VA-E-00008-001
8	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	Bridge	Crane drive		1	EKOM-VA-E-00009-001
9	BD/EKOM/63 07056	GEARBOX. MOTOR TRAVELLING 30 07012	Bridge	Crane drive		1	EKOM-VA-E-00009-001
10		DRIVE PINION	Bridge	Crane drive		2	E900-11915-M-00037-004
11		DRIVE CHAIN	Bridge	Crane drive		2	EKOM-VA-E-00008-001
12		TRAVEL WHEELS	Bridge	Travel wheels		8	E900-11915-M-00037-001
13		TROLLEY GEAR RACK	Bridge	Trolley gear rack		2	E900-11915-M-00037-001
14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	Hoist	Hoist drive		1	E900-11915-M-00037-002
15		GEARBOX MOTOR HOIST INTERMITTENT	Hoist	Hoist drive		1	E900-11915-M-00037-002
16		GEARBOX MOTOR HOIST MAIN	Hoist	Hoist drive		1	E900-11915-M-00037-002
17	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	Hoist	Lower block		1	E900-11915-M-00037-002
18		UPPER BLOCK	Hoist	Upper block		1	E900-11915-M-00037-002
19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	Hoist	Wire rope		1	E900-11915-M-00037-002
20		WIRE END CONNECTION OUTER	Hoist	Wire rope		1	E900-11915-M-00037-002
21		WIRE END CONNECTION	Hoist	Wire rope clamp		1	E900-11915-M-00037-002
22	BD/EKOM/43 ZE-29556	ELEMENT POSITION REFLECTOR "A" 19 07010	Instrument	Anti-collision		1	EKOM-VA-E-00101-001
23	BD/EKOM/43 ZE-29557	ELEMENT POSITION REFLECTOR "B" 19 07010	Instrument	Anti-collision		1	EKOM-VA-E-00101-001
24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	Instrument	Anti-collision	Protection	1	EKOM-VA-E-00101-001
25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	Instrument	Anti-collision	Protection	1	EKOM-VA-E-00101-001
26	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	Instrument	Electrical protection devices	Protection	1	EKOM-VA-E-00008-001
27	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	Instrument	Electrical protection devices	Protection	1	EKOM-VA-E-00008-001
28	BD/EKOM/28 JB-08238	JUNCTION BOX	Instrument	Junction box		1	EKOM-VA-E-00101-001
29	BD/EKOM/28 JE-07010	BOX JUNCTION OVERHEAD CRANE 19 07010	Instrument	Junction box		1	EKOM-VA-E-00101-001
30	BD/EKOM/43 JB-03961	JB OVERRIDE SWITCH ANTI COLL. 19-07010	Instrument	Junction box	Control	1	EKOM-VA-E-00101-001
31	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07010	Instrument	Junction box		1	EKOM-VA-E-00101-001
32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00076-001
33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00076-001
34	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	Instrument	Limit switch hoist	Protection	1	E900-11915-E-00076-001
35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00076-001
36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00076-001
37		OVERLOAD SWITCH HOIST	Instrument	Overload switch hoist	Protection	1	E900-11915-E-00076-001
38	BD/EKOM/28 07010	SWITCH MAIN FOR OVERHEAD CRANE 19 07010	Instrument	Pennant	Control	1	E900-11915-E-00076-001
39	BD/EKOM/28 07011	SWITCH PUSH BUTTON STATION FOR 19 07010	Instrument	Pennant	Control	1	E900-11915-E-00076-001
40	BD/EKOM/28 08293	SWITCH EMERG STOP CRANE 19 07010	Instrument	Pennant	Control	1	EKOM-VA-E-00101-001
41	BD/EKOM/28 LCP-07010	PANEL CONTROL. OVERHEAD CRANE 19 07010	Instrument	Radio remote	Control	1	EKOM-VA-E-00101-001
42	BD/EKOM/19 07558	PADEYE TEST SWL 35T (FOR OT CRANE)	Other	-		1	
43		BRIDGE GEAR RACK	Runway	Runway beams		2	E900-11915-M-00006-001
44		RUNWAY BEAMS	Runway	Runway beams		2	E900-11915-M-00006-001
45		TROLLEY TRAVEL WHEELS	Trolley	Travelling wheels		6	E900-11915-M-00037-002
46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	Trolley	Trolley drive		1	E900-11915-M-00037-002
47		GEARBOX TROLLEY MOTOR	Trolley	Trolley drive		1	E900-11915-M-00037-002
48		PINION TROLLEY DRIVE	Trolley	Trolley drive		1	E900-11915-M-00037-002

3-5 Equipment history

Date	TAG No.	Description	System	Sub-system	Failure mode	Failure Cause
06.01.2006		Overload switch hoist tripping	Instrument	Overload switch hoist	Incorrect	Incorrect setting from manufacturer.
02.03.2006		Crane drive axle	Bridge	Crane Drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
04.03.2006		Drive chain thightener	Bridge	Crane Drive	Missing	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
04.03.2006		Crane drive axle bearings	Bridge	Crane Drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
09.04.2006		Usermanual sign	Other	-	Incorrect	Missing marking on site
12.05.2006		Lubrication	Other	-	Missing	General notification about missing lubrication
21.06.2006		Crane drive axle	Bridge	Crane Drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
13.08.2006		Crane drive axle	Bridge	Crane Drive	Damaged	Collision with the other 25T crane
14.12.2006		Crane drive axle	Bridge	Crane Drive	Damaged	Bearing for drive axle damaged.
26.02.2007		Upper block	Hoist	Upper block	Corroded	A bad solutions for support axle exposes the upper block for corrosion
18.04.2007		Upper block	Hoist	Upper block	Corroded	Segring broken on both cranes, no cause
22.04.2007		Cable tray	Bridge	Cable tray	Damaged	Unknown
24.04.2007	BD/EKOM/28 07011	Pendant	Instrument	Pendant	Damaged	Unknown
25.04.2007	BD/EKOM/28 LCP-07010	Earth Fault protection	Instrument	Electrical Protection Devices	False indication	Unknown
25.04.2007	BD/EKOM/28 07011	Wire for Pendant	Instrument	Pendant	False indication	Unknown
26.06.2007	BD/EKOM/30 07011	New tag no. For cable and junction box	Instrument	Junction box	Missing	Missing from production of crane
11.09.2007		Drive chain	Bridge	Crane Drive	Missing	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
21.09.2007		Coupling for drive	Bridge	Crane Drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
21.09.2007		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
19.11.2007		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
19.11.2007		Wrong marking on pendant	Instrument	Pendant	Missing	Missing from production of crane
21.04.2008	BD/EKOM/28 07011	Pendant	Instrument	Pendant	Damaged	Unknown
09.05.2008		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
13.02.2009		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
16.03.2009		Cable tray	Bridge	Cable tray	Damaged	Cable tray collides with something when the crane is driven.
28.03.2009		Cable tray	Bridge	Cable tray	Damaged	Cable tray collides with something when the crane is driven.
21.05.2009	BD/EKOM/28 07011	Pendant	Instrument	Pendant	Fluctuates	Water inside the pendant
29.05.2009	BD/EKOM/28 07011	Emergency stop	Instrument	Pendant	Defective	Unknown - Water?
11.06.2009	BD/EKOM/19 02823	Bolt in safety latch	Hoist	Lower block	Defective	Unknown
11.06.2009	BD/EKOM/43 ZS-01854	South limit switch	Instrument	Limit switch bridge	Defective	Unknown
11.06.2009		Bearing and simmering for drum	Hoist	Drum	Damaged	Unknown - Water?
31.08.2009		Bearing for drive axle	Bridge	Crane Drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
22.10.2009		Bearing for drive axle	Bridge	Crane Drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit.
10.02.2010	BD/EKOM/28 07011	Pendant	Instrument	Pendant	Defective	Unknown - Water?
12.03.2010		Highspeed not functioning	Instrument	Relay	Defective	Unknown
13.03.2010		Limit switch hoist	Instrument	Limit switch hoist	Incorrect	Unknown
26.07.2010	BD/EKOM/28 07011	Emergency stop	Instrument	Pendant	Defective	Unknown
17.11.2010		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
23.11.2010		Electrical motor trolley	Trolley	Trolley drive	Out of balance	Unknown
01.01.2011		Main gear hoist	Hoist	Hoist drive	Leak	Unknown
04.05.2011		Overload switch hoist tripping	Instrument	Overload switch hoist	Incorrect	Unknown
06.08.2011		Wire rope	Hoist	Wire rope	Damaged	Unknown

08.08.2011		Bearing and simmering for drum	Hoist	Drum	Damaged	Wire rope had been wrapped around the axle
25.12.2011		Electrical protection device	Instrument	Electrical Protection Devices	Defective	Unknown
09.02.2012	BD/EKOM/28 LCP-07010	Radio remote	Instrument	Radio remote	Disconnected	Unknown
09.02.2012		Bridge skew in plane	Bridge	Crane Drive	Jammed	A support between the bridge girders were missing for manufacturer
19.03.2012		Anti-collision	Instrument	Anti-collision	Unstable	Unknown - Moisture?
19.03.2012		Brake does not hold the rated load	Hoist	Hoist drive	Defective	Unknown
24.07.2012		Key to radio remote	Instrument	Radio remote	Broken	Unknown
09.03.2013		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
09.03.2013		Overload switch hoist	Instrument	Overload switch hoist	Incorrect	Unknown
05.06.2013	BD/EKOM/43 JB-03961	Override switch for Anti-collision	Instrument	Anti-collision	Jammed	Wrong material in switches
07.12.2013		Limit switch hoist	Instrument	Limit switch hoist	Incorrect	Unknown
07.12.2013		Wire rope clamp	Hoist	Wire rope clamp	Incorrect	Human error
10.02.2014		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error, wrong use
15.03.2014		Overload switch hoist	Instrument	Overload switch hoist	Incorrect	Unknown
27.08.2014		Derailment protection device	Hoist	Derailment protection	Incorrect	Unknown
29.08.2014		Limit switch hoist	Instrument	Limit switch hoist	Incorrect	Unknown
16.03.2015		Drive chain	Bridge	Crane Drive	Broken	Unknown
16.03.2015		Padeye for testing	Other		Missing	Because of the drill string it is not possible to connect to the padeye for testing (The drill string to be moved prior to testing).
08.06.2015		Key to radio remote	Instrument	Radio remote	Broken	Unknown
12.10.2015		Anti-collision	Instrument	Anti-collision	False indication	Unknown - Moisture?
09.03.2016	BD/EKOM/28 07011	Marking of pendant	Instrument	Pendant	Incorrect	Unknown
13.03.2017	BD/EKOM/28 07011	Marking of emergency stop	Instrument	Pendant	Incorrect	Unknown
13.03.2017		Drive chain	Bridge	Crane Drive	Worn	Unknown

4 - Functional failure

Function #	FF #	Function/Functional failure
2		Dampen and mitigate collision if needed
	2.1	No damping of bridge
3		Carry the cables when the trolley is moving
	3.1	Cables fall off
	3.2	Cable tray collides with other structure
4/5		Heat the motor housing to prevent moisture inside housing
	4.1	No heating
	4.2	Overheating
6/7		Transmit rotational forces through gearbox, drive chain and pinion in order to move bridge
	6.1	Bridge stationary
	6.2	Bridge movement stuttering
	6.3	Bridge moving in wrong direction
8/9		Transmit rotational forces from motor to drive chain in order to move bridge
	8.1	Bridge stationary
	8.2	Bridge movement stuttering
10		Transmit rotational forces from drive chain in order to move bridge
	10.1	Bridge stationary
	10.2	Bridge movement stuttering
11		Transmit rotational forces from gearbox in order to move bridge
	11.1	Bridge stationary
	11.2	Bridge movement stuttering
12		Support bridge on runway and move bridge smooth
	12.1	Bridge stationary
	12.2	Bridge movement stuttering
	12.3	Load falling
13		Enable smooth movement of the trolley
	13.1	Trolley stationary
	13.2	Trolley movement stuttering
14		Moving or hold the hoist drum in order to lift a load
	14.1	Hook stationary
	14.2	Hook movement stuttering
	14.3	Hook moving in wrong direction
	14.3	Load falling
15		Transmit rotational forces from motor to main gearbox
	15.1	Hook stationary
	15.2	Hook movement stuttering
	15.3	Load falling
16		Transmit rotational forces from intermittent gearbox to drum
	16.1	Hook stationary
	16.2	Hook movement stuttering
	16.3	Load falling
17		Lifting load by hook, wire rope running through sheave wheels
	17.1	Hook stationary
	17.2	Hook movement stuttering
	17.3	Hook swivel not moving
18		Guide wire rope
	18.1	Hook stationary
	18.2	Hook movement stuttering
	18.3	Load falling
19		Move the hook and load up and down
	19.1	Hook stationary

	19,2	Load falling
20		Hold the dead end of the wire rope
	20,1	Hook stationary
	20,2	Load falling
21		Hold the dead end of the wire rope on the drum into position
	21,1	Hook stationary
	21,2	Load falling
22		Reflect the optical beam from anti-collision North side of crane bridge
	22,1	No reflection of optical beam (Crane bridge not moving north) - Bridge stationary
23		Reflect the optical beam from anti-collision South side of crane bridge
	23,1	No reflection of optical beam (Crane bridge not moving south) - Bridge stationary
24		Send out optical beam for anti-collision South side of crane bridge
	24,1	Activated when there is no obstacle (Crane bridge not moving south) - Bridge stationary
	24,2	Not activated when there is a obstacle (Crane colliding)
25		Send out optical beam for anti-collision North side of crane bridge
	25,1	Activated when there is no obstacle (Crane bridge not moving north) - Bridge stationary
	25,2	Not activated when there is a obstacle (Crane colliding)
26		Alert the control system if motor for bridge travelling east have a temperatur over a given threshold
	26,1	No feedback from termistor (Bridge stationary)
	26,2	Unvalid feedback from termistor (Bridge stationary)
27		Alert the control system if motor for bridge travelling west have a temperatur over a given threshold
	27,1	No feedback from termistor (Bridge stationary)
	27,2	Unvalid feedback from termistor (Bridge stationary)
28		Bridge crane drive west - Hold electrical connections
	28,1	No connection through junction box (Bridge stationary)
	28,2	Sporadically connection through junction box (Bridge movement stuttering)
29		Bridge crane drive east - Hold electrical connections
	29,1	No connection through junction box (Bridge stationary)
	29,2	Sporadically connection through junction box (Bridge movement stuttering)
30		Override anti-collision protection system
	30,1	Not possible to override anti-collision - Bridge stationary
	30,2	Override anti-collision system when not activated - Collision
31		Anti-collision system - Hold electrical connections
	31,1	No connection through junction box (Bridge not moving north)
	31,2	No connection through junction box (Bridge not moving south)
	31,3	Sporadically connection through junction box (Bridge movement stuttering when moving north)
	31,4	Sporadically connection through junction box (Bridge movement stuttering when moving south)
32		Prevent the crane from moving into the other crane
	32,1	Bridge not moving south
	32,2	Bridge movement stuttering when moving south
	32,3	Crane collision
33		Prevent the crane from moving into the buffer
	33,1	Bridge not moving north
	33,2	Bridge movement stuttering when moving north
	33,3	Crane touching the buffer north buffer and continue running north
34		Prevent the hook from been pull into the upper sheave or drum, and prevent the hook from touching the floor
	34,1	Hook stationary
	34,2	Hook moving into sheave or drum
	34,3	Hook touching the floor and wire going slack
35		Prevent the trolley from running into the east buffer
	35,1	Trolley not moving east
	35,2	Trolley movement stuttering when moving east

	35,3	Trolley touching the east buffer and continue running east
36		Prevent the trolley from running into the west buffer
	36,1	Trolley not moving west
	36,2	Trolley movement stuttering when moving west
	36,3	Trolley touching the east buffer and continue running west
37		Prevent overloading of hoist
	37,1	Hoist not lifting at all
	37,2	Hoist not lifting sufficient load (Insufficient capacity)
	37,3	Hoist overloaded
38		Powering the crane
	38,1	Crane does not get power
	38,2	Power will not be disconnected (Crane will not stop)
39		Operate the crane functions when radio control is disconnected (emergency operation)
	39,1	Crane bridge stationary
	39,2	Crane bridge stuttering
	39,3	Crane bridge moving in the wrong direction
	39,4	Trolley stationary
	39,5	Trolley stuttering
	39,6	Trolley moving in wrong direction
	39,7	Hook stationary
	39,8	Hook movement stuttering
	39,9	Hook moving in wrong direction
	39,10	Crane stuck in high speed
	39,11	Crane stuck in low speed
	39,12	Crane will not stop
	39,13	Crane will not reset (All functions stationary)
40		Emergency stop all crane functions
	40,1	Crane not working
	40,2	Crane not stopping when emergency stop is activated
41		Operate the crane functions
	41,1	Crane bridge stationary
	41,2	Crane bridge stuttering
	41,3	Crane bridge moving in the wrong direction
	41,4	Crane bridge stuttering when moving south
	41,5	Trolley stationary
	41,6	Trolley stuttering
	41,7	Trolley moving in wrong direction
	41,8	Hook stationary
	41,9	Hook movement stuttering
	41,10	Hook moving in wrong direction
	41,11	Crane will not stop
	41,12	Crane will not reset (All functions stationary)
42		Point of attaching the crane for load testing
	42,1	Pulling out the load test point when applying load (Not holding the test load)
43		Enable smooth movement of the bridge
	43,1	Bridge stationary
	43,2	Bridge movement stuttering
44		Support the bridge
	44,1	Bridge falls down - Load falling
45		Support trolley on bridge and move trolley smooth
	45,1	Trolley stationary
	45,2	Trolley movement stuttering

	45.3	Load falling
46		Transmit rotational forces through gearbox, drive chain and pinion in order to move the trolley
	46.1	Trolley stationary
	46.2	Trolley movement stuttering
	46.3	Trolley moving in wrong direction
47		Transmit rotational forces from motor to pinion in order to move the trolley
	47.1	Trolley stationary
	47.2	Trolley movement stuttering
48		Transmit rotational forces from gearbox to gear rack in order to move the trolley
	48.1	Trolley stationary
	48.2	Trolley movement stuttering

5-1 Equipment-functional failure matrix

No.	TAG No.	Component description	Functional failures	2.1 - No Damping of bridge	3.1 Cables fall off	3.2 Collision with other structure	4.1 No heating	4.2 Overheating	6.1 Bridge stationary	6.2 Bridge movement stuttering	6.3 Bridge moving in wrong direction	12.3 Load falling	13.1 Trolley stationary	13.2 Trolley movement stuttering	14.1 Hook stationary
2		BUMPER	X												
3		CABLE TRAY		3.2	X										
4	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012				X	4.1								
5	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258				X	4.1								
6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010						X	6.1	O					
7	BD/EKOM/30 07258	MOTOR TRAVEL W. CRANE OVERHEAD. 19 07010						X	6.1	O					
8	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258						X	6.1						
9	BD/EKOM/63 07056	GEARBOX. MOTOR TRAVELLING 30 07012						X	6.1						
10		DRIVE PINION						X	6.1						
11		DRIVE CHAIN						X	6.1						
12		TRAVEL WHEELS						X	6.1		X				
13		TROLLEY GEAR RACK										X	13.1		
14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010									X				X
15		GEARBOX MOTOR HOIST INTERMITTENT									14.1				X
16		GEARBOX MOTOR HOIST MAIN									14.1				X
17	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK									X				X
18		UPPER BLOCK									X				X
19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T									14.1				X
20		WIRE END CONNECTION OUTER									14.1				X
21		WIRE END CONNECTION									14.1				X
22	BD/EKOM/43 ZE-29556	ELEMENT POSITION REFLECTOR "A" 19 07010						X							
23	BD/EKOM/43 ZE-29557	ELEMENT POSITION REFLECTOR "B" 19 07010						X							
24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010			6.1			X							
25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010			6.1			X							
26	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012						X							
27	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258						X							
28	BD/EKOM/28 JB-08238	JUNCTION BOX						X	6.1						
29	BD/EKOM/28 JE-07010	BOX JUNCTION OVERHEAD CRANE 19 07010						X	6.1						
30	BD/EKOM/43 JB-03961	JB OVERRIDE SWITCH ANTI COLL. 19-07010			6.1			X	6.1						
31	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07010						X	6.1						
32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010			6.1			X	6.1						
33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010			6.1			X	6.1						
34	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010													X
35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010			13.1							X	13.1		
36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010			13.1							X	13.1		
37		OVERLOAD SWITCH HOIST													X
38	BD/EKOM/28 07010	SWITCH MAIN FOR OVERHEAD CRANE 19 07010						X				6.1			6.1
39	BD/EKOM/28 07011	SWITCH PUSH BUTTON STATION FOR 19 07010						X	6.1	O		6.1	6.1		6.1
40	BD/EKOM/28 08293	SWITCH EMERG STOP CRANE 19 07010						X				6.1			6.1
41	BD/EKOM/28 LCP-07010	PANEL CONTROL. OVERHEAD CRANE 19 07010						X	6.1	O		6.1	6.1		6.1
42	BD/EKOM/19 07558	PADEYE TEST SWL 35T (FOR OT CRANE)													
43		BRIDGE GEAR RACK						X	6.1						
44		RUNWAY BEAMS									X				
45		TROLLEY TRAVEL WHEELS									X	X	13.1		
46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010										X	13.1		
47		GEARBOX TROLLEY MOTOR										X	13.1		
48		PINION TROLLEY DRIVE										X	13.1		

FF#	COMP	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Local	System	Plant	LTA
2,1	2		BUMPER	2,1	Brittle	2.1.1	Age	Broken bumpers	Limited damping of bridge if collision	None imidiate	Yes
3,20	3		CABLE TRAY	3,1	Bent	3.1.1	Colliding into other structures, because of hooking	Cables could be broken	No connection with motors or instruments	Material handling not possible	Yes
4,1	4	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012	4,1	Shorted	4.1.1	Age	No heating in motor	Bridge function could stop working if motor gets excces moisture	None imidiate	Yes
4,1	5	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258	5,1	Shorted	5.1.1	Age	No heating in motor	Bridge function could stop working if motor gets excces moisture	None imidiate	Yes
6,10	6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,1	Motor bearing defective	6.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6,10	6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,2	Motor cage or rotor defective	6.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6,10	6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,3	Brake not releasing	6.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6,10	7	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,1	Motor bearing defective	7.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6,10	7	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,2	Motor cage or rotor defective	7.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6,10	7	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,3	Brake not releasing	7.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6,1	8	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	8,1	Gearbox not rotating	8.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
6,1	9	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	9,1	Gearbox not rotating	9.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
6,1	10		DRIVE PINION	10,1	Drive pinion not rotating	10.1.1	Broken theets	No movent on rack drive	Bridge travel restricted	Material handling not possible	Yes
6,1	11		DRIVE CHAIN	11,1	Drive chain broken	11.1.1	Aberration	No movement on pinion	Bridge travel restricted	Material handling not possible	Yes
6,1	12		TRAVEL WHEELS	12,1	Deformed	12.1.1	Bearing failure	Limited movement	Bridge travel restricted	Material handling not possible	Yes
6,1	22	BD/EKOM/43 ZE-29556	ELEMENT POSITION REFLECTOR "A" 19 07010	22,1	Missing	22.1.1	Detached from location	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	23	BD/EKOM/43 ZE-29557	ELEMENT POSITION REFLECTOR "B" 19 07010	23,1	Missing	23.1.1	Detached from location	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,1	False indication	24.1.1	Dirty due to lack of cleaning	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,1	False indication	24.1.2	Missing heating elements or lack of removal of moisture	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,2	Broken	24.2.1	Broken due to moisture	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,1	False indication	25.1.1	Dirty due to lack of cleaning	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,1	False indication	25.1.2	Missing heating elements or lack of removal of moisture	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,2	Broken	25.2.1	Broken due to moisture	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	26	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,1	Shorted	26.1.1	Age	No movement in drive motor east	Bridge travel restricted	Material handling not possible	Yes
6,1	26	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,2	False indication	26.2.1	Age	No movement in drive motor east	Bridge travel restricted	Material handling not possible	Yes
6,1	27	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,1	Shorted	27.1.1	Age	No movement in drive motor west	Bridge travel restricted	Material handling not possible	Yes
6,1	27	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,2	False indication	27.2.1	Age	No movement in drive motor west	Bridge travel restricted	Material handling not possible	Yes
6,1	28	BD/EKOM/28 JB-08238	JUNCTION BOX	28,1	Shorted	28.1.1	Shorted because of moisture	No movement in drive motor west	Bridge travel restricted	Material handling not possible	Yes
6,1	29	BD/EKOM/28 JE-07010	BOX JUNCTION OVERHEAD CRANE 19 07010	29,1	Shorted	29.1.1	Shorted because of moisture	No movement in drive motor east	Bridge travel restricted	Material handling not possible	Yes

6,1	30	BD/EKOM/43 JB-03961	JB OVERRIDE SWITCH ANTI COLL. 19-07010	30,1	Shorted	30.1.1	Shorted because of moisture - Connection broken	Not possible to override anti-collision	Bridge travel restricted if anti-collision is activated	Material handling not possible if anti-collision is unintendedly activated	Yes
6,1	31	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07010	31,1	Shorted	31.1.1	Shorted because of moisture - Connection broken	Anti-collision activated	Bridge travel restricted one or both directions	Moving the crane in one or both directions is not possible	Yes
6,1	32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,1	False indication	32.1.1	Age	Limit switch activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,1	False indication	32.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,2	Broken	32.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6,1	33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	33,1	False indication	33.1.1	Age	Limit switch activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,1	False indication	32.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,2	Broken	32.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6,1	38	BD/EKOM/28 07010	SWITCH MAIN FOR OVERHEAD CRANE 19 07010	38,1	Shorted	38.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
6,1	39	BD/EKOM/28 07011	SWITCH PUSH BUTTON STATION FOR 19 07010	39,1	Shorted	39.1.1	Shorted because of moisture	Bridge control function not working	Bridge travel restricted	Material handling not possible	Yes
6,1	40	BD/EKOM/28 08293	SWITCH EMERG STOP CRANE 19 07010	40,1	Shorted	40.1.1	Shorted because of moisture	Not possible to start the crane	Not possible to start the crane	Material handling not possible	Yes
6,1	41	BD/EKOM/28 LCP-07010	PANEL CONTROL. OVERHEAD CRANE 19 07010	41,1	Shorted	41.1.1	Shorted because of moisture	Not possible to start the crane	Not possible to start the crane	Material handling not possible	Yes
6,1	43		BRIDGE GEAR RACK	43,1	Broken	43.1.1	Missing rack theets	No contact between pinion and rack	Bridge travel restricted	Material handling not possible	Yes
12,3	12		TRAVEL WHEELS	12,2	Structural failure	12.2.1	Massive degradation to structure	Overload of existing structure.	Bridge collapse	Crane collapse	Yes
12,3	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,4	Brake not engaging	14.4.1	Wear and tear	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
12,3	17	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,2	Severe structural corrosion	17.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
12,3	18		UPPER BLOCK	18,2	Severe structural corrosion	18.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
12,3	44		RUNWAY BEAMS	44,1	Severe structural corrosion	44.1.1	Lack of sufficient cross section in structureal supports	Not holding load	Crane runway falling down	Crane collapse	Yes
12,3	45		TROLLEY TRAVEL WHEELS	45,1	Severe structural corrosion	45.1.1	Lack of sufficient cross section in axle	Not holding load	Trolley boogie falling down	Trolley collapse	Yes
13,1	13		TROLLEY GEAR RACK	13,1	Broken	13.1.1	Missing rack theets	No contact between pinion and rack	Trolley travel restricted	Material handling not possible	Yes
13,1	35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,1	False indication	35.1.1	Age	Not possible to move the trolley in west direction	Trolley travel restricted west	Material handling limited	Yes
13,1	35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,1	False indication	35.1.2	Dirt activating the switch	Not possible to move the trolley in west direction	Trolley travel restricted west	Material handling limited	Yes
13,1	35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,2	Broken	35.2.1	Moisture in the electronics	Not possible to move the trolley in west direction	Trolley travel restricted west	Material handling limited	Yes
13,1	36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,1	False indication	36.1.1	Age	Not possible to move the trolley in east direction	Trolley travel restricted east	Material handling limited	Yes
13,1	36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,1	False indication	36.1.2	Dirt activating the switch	Not possible to move the trolley in east direction	Trolley travel restricted east	Material handling limited	Yes
13,1	36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,2	Broken	36.2.1	Moisture in the electronics	Not possible to move the trolley in east direction	Trolley travel restricted east	Material handling limited	Yes
13,1	45		TROLLEY TRAVEL WHEELS	45,1	Deformed	45.1.1	Bearing failure	Limited movement	Trolley travel restricted	Material handling not possible	Yes
13,1	46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,1	Motor bearing defective	13.1.1	Insufficient lubrication	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
13,1	46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,2	Motor cage or rotor defective	13.2.1	Age	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
13,1	46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,3	Brake not releasing	13.3.1	Worn brake	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
13,1	47		GEARBOX TROLLEY MOTOR	47,1	Gearbox not rotating	47.1.1	Broken gears	No movement in output axle	Trolley travel restricted	Material handling not possible	Yes

13,1	48		PINION TROLLEY DRIVE	48,1	Drive pinion not rotating	48.1.1	Broken theets	No movent on rack drive	Trolley travel restricted	Material handling not possible	Yes
14,1	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,1	Motor bearing defective	14.1.1	Insufficient lubrication	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
14,1	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,2	Motor cage or rotor defective	14.2.1	Age	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
14,1	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,3	Brake not releasing	14.3.1	Worn brake	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
14,1	15		GEARBOX MOTOR HOIST INTERMITTENT	15,1	Gearbox not rotating	15.1.1	Broken gears	No movement in output axle	Hoist movement restricted	Material handling not possible	Yes
14,1	16		GEARBOX MOTOR HOIST MAIN	16,1	Gearbox not rotating	16.1.1	Broken gears	No movement in output axle	Hoist movement restricted	Material handling not possible	Yes
14,1	17	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,1	Corrosion in bearings	17.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
14,1	18		UPPER BLOCK	18,1	Corrosion in bearings	18.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
14,1	19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,1	Broken	19.1.1	Broken because of severe missuse or deterioation	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
14,1	19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,2	Missing	19.2.1	Not installed	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
14,1	19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,3	Corroded	19.3.1	Lack of lubrication	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
14,1	20		WIRE END CONNECTION OUTER	20,1	Broken	20.1.1	Broken because of severe missuse or deterioation	No end connection able to hold the load.	Hook movement restricted	Material handling not possible	Yes
14,1	20		WIRE END CONNECTION OUTER	20,1	Corroded	20.2.1	Moisture	No end connection able to hold the load.	Hook movement restricted	Material handling not possible	Yes
14,1	21		WIRE END CONNECTION	21,1	Broken	21.1.1	Broken because of severe missuse or deterioation	No end connection able to hold the load if wire is spooled all out of the drum	None imidiate	None imidiate	Yes
14,1	21		WIRE END CONNECTION	21,2	Corroded	21.2.1	Moisture	No end connection able to hold the load if wire is spooled all out of the drum	None imidiate	None imidiate	Yes
14,1	34	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,1	False indication	34.1.1	Age	Limit switch activated	Could give restictions for how low the hook can be lovered and how high a load can be lifted	None imidiate	Yes
14,1	34	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,2	Incorrect setting	34.2.1	Unkown	Limit switch activated	Could give restictions for how low the hook can be lovered and how high a load can be lifted	None imidiate	Yes
14,1	37		OVERLOAD SWITCH HOIST	37,1	False indication	37.1.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
14,1	37		OVERLOAD SWITCH HOIST	37,2	Incorrect setting	37.1.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
42,1	42	BD/EKOM/19 07558	PADEYE TEST SWL 35T (FOR OT CRANE)	42,1	Overstress	42.1.1	Tear out due to loss of cross section	Destroyed padeye	Not possible to load test	None imidiate, though load testing is not possible	Yes

FF#	COMP	TAG	Component Description	FM#	Failure Mode	Evident?	Safety	Outage	Cat	Comment
2,10	2		BUMPER	2,1	Brittle	No	No	No	D/C	
3,20	3		CABLE TRAY	3,1	Bent	Yes	No	Yes	B	Could stop the whole crane
4,10	4	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012	4,1	Shorted	No	No	Yes	D/C	
4,10	5	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258	5,1	Shorted	No	No	Yes	D/C	
6,10	6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6.1	Motor bearing defective	Yes	No	Yes	B	
6,10	6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6.2	Motor cage or rotor defective	Yes	No	Yes	B	
6,10	6	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6.3	Brake not releasing	Yes	No	Yes	B	
6,10	7	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7.1	Motor bearing defective	Yes	No	Yes	B	
6,10	7	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7.2	Motor cage or rotor defective	Yes	No	Yes	B	
6,10	7	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7.3	Brake not releasing	Yes	No	Yes	B	
6,10	8	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	8,1	Gearbox not rotating	Yes	No	Yes	B	
6,10	9	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	9,1	Gearbox not rotating	Yes	No	Yes	B	
6,10	10		DRIVE PINION	10,1	Drive pinion not rotating	Yes	No	Yes	B	
6,10	11		DRIVE CHAIN	11,1	Drive chain broken	Yes	No	Yes	B	
6,10	12		TRAVEL WHEELS	12,1	Deformed	Yes	No	Yes	B	
6,10	22	BD/EKOM/43 ZE-29556	ELEMENT POSITION REFLECTOR "A" 19 07010	22,1	Missing	Yes	No	Yes	B	
6,10	23	BD/EKOM/43 ZE-29557	ELEMENT POSITION REFLECTOR "B" 19 07010	23,1	Missing	Yes	No	Yes	B	
6,10	24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,1	False indication	Yes	Yes		A	
6,10	24	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,2	Broken	Yes	Yes		A	
6,10	25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,1	False indication	Yes	Yes		A	
6,10	25	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,2	Broken	Yes	Yes		A	
6,10	26	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,1	Shorted	Yes	No	Yes	B	
6,10	26	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,2	False indication	Yes	No	Yes	B	
6,10	27	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,1	Shorted	Yes	No	Yes	B	
6,10	27	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,2	False indication	Yes	No	Yes	B	
6,10	28	BD/EKOM/28 JB-08238	JUNCTION BOX	28,1	Shorted	Yes	No	Yes	B	
6,10	29	BD/EKOM/28 JE-07010	BOX JUNCTION OVERHEAD CRANE 19 07010	29,1	Shorted	Yes	No	Yes	B	
6,10	30	BD/EKOM/43 JB-03961	JB OVERRIDE SWITCH ANTI COLL. 19-07010	30,1	Shorted	Yes	Yes		A	
6,10	31	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07010	31,1	Shorted	Yes	Yes		A	
6,10	32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,1	False indication	Yes	Yes		A	
6,10	32	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,2	Broken	Yes	Yes		A	
6,10	33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	33,1	False indication	Yes	Yes		A	
6,10	33	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	33,2	Broken	Yes	Yes		A	

6,10	38	BD/EKOM/28 07010	SWITCH MAIN FOR OVERHEAD CRANE 19 07010	38,1	Shorted	Yes	No	Yes	B
6,10	39	BD/EKOM/28 07011	SWITCH PUSH BUTTON STATION FOR 19 07010	39,1	Shorted	Yes	Yes		A
6,10	40	BD/EKOM/28 08293	SWITCH EMERG STOP CRANE 19 07010	40,1	Shorted	Yes	Yes		A
6,10	41	BD/EKOM/28 LCP-07010	PANEL CONTROL. OVERHEAD CRANE 19 07010	41,1	Shorted	Yes	Yes		A
6,10	43		BRIDGE GEAR RACK	43,1	Broken	Yes	No	Yes	B
12,30	12		TRAVEL WHEELS	12,2	Structural failure	Yes	Yes		A
12,30	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,4	Brake not engaging	Yes	Yes		A
12,30	17	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,2	Severe structural corrosion	Yes	Yes		A
12,30	18		UPPER BLOCK	18,2	Severe structural corrosion	Yes	Yes		A
12,30	44		RUNWAY BEAMS	44,1	Severe structural corrosion	Yes	Yes		A
12,30	45		TROLLEY TRAVEL WHEELS	45,1	Severe structural corrosion	Yes	Yes		A
13,10	13		TROLLEY GEAR RACK	13,1	Broken	Yes	No	Yes	B
13,10	35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,1	False indication	Yes	Yes		A
13,10	35	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,2	Broken	Yes	Yes		A
13,10	36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,1	False indication	Yes	Yes		A
13,10	36	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,2	Broken	Yes	Yes		A
13,10	45		TROLLEY TRAVEL WHEELS	45,1	Deformed	Yes	No	Yes	B
13,10	46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,1	Motor bearing defective	Yes	No	Yes	B
13,10	46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,2	Motor cage or rotor defective	Yes	No	Yes	B
13,10	46	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,3	Brake not releasing	Yes	No	Yes	B
13,10	47		GEARBOX TROLLEY MOTOR	47,1	Gearbox not rotating	Yes	No	Yes	B
13,10	48		PINION TROLLEY DRIVE	48,1	Drive pinion not rotating	Yes	No	Yes	B
14,10	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,1	Motor bearing defective	Yes	No	Yes	B
14,10	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,2	Motor cage or rotor defective	Yes	No	Yes	B
14,10	14	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,3	Brake not releasing	Yes	No	Yes	B
14,10	15		GEARBOX MOTOR HOIST INTERMITTENT	15,1	Gearbox not rotating	Yes	Yes		A
14,10	16		GEARBOX MOTOR HOIST MAIN	16,1	Gearbox not rotating	Yes	Yes		A
14,10	17	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,1	Corrosion in bearings	Yes	No	Yes	B
14,10	18		UPPER BLOCK	18,1	Corrosion in bearings	Yes	No	Yes	B
14,10	19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,1	Broken	Yes	Yes		A
14,10	19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,2	Missing	Yes	Yes		A
14,10	19	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,3	Corroded	Yes	Yes		A

14,10	20		WIRE END CONNECTION OUTER	20,1	Broken	Yes	Yes		A	
14,10	20		WIRE END CONNECTION OUTER	20,1	Corroded	Yes	Yes		A	
14,10	21		WIRE END CONNECTION	21,1	Broken	Yes	Yes		A	
14,10	21		WIRE END CONNECTION	21,2	Corroded	Yes	Yes		A	
14,10	34	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,1	False indication	Yes	Yes		A	
14,10	34	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,2	Incorrect setting	Yes	Yes		A	
14,10	37		OVERLOAD SWITCH HOIST	37,1	False indication	Yes	Yes		A	
14,10	37		OVERLOAD SWITCH HOIST	37,2	Incorrect setting	Yes	Yes		A	
42,10	42	BD/EKOM/19 07558	PADEYE TEST SWL 35T (FOR OT CRANE)	42,1	Overstress	Yes	Yes		A	

7-1 - Task selection

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Cat	1	2	3	4	5	6	7	Candidate Tas	Effective Info	Selective dec.	Est Freq.
6,10	24	Instrument	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,1	False indication	24.1.1	Dirty due to lack of cleaning	A	P	Y	N	N	-	N	Y	1. Inspect and clean - TD 2. Assess possibility of heat tracing	Based on semi-qualitative information. Should be inspected and cleaned before well intervention campaigns	1. Inspect and clean - TD	3M
6,10	24	Instrument	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,2	Broken	24.2.1	Broken due to moisture	A									Not applicable. Covered by FM 24.1		
6,10	25	Instrument	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,1	False indication	25.1.1	Dirty due to lack of cleaning	A	P	Y	N	N	-	N	Y	1. Inspect and clean - TD 2. Assess possibility of heat tracing	Based on semi-qualitative information. Should be inspected and cleaned before well intervention campaigns	1. Inspect and clean - TD	3M
6,10	25	Instrument	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,2	Broken	25.2.1	Broken due to moisture	A									Not applicable. Covered by FM 25.1		
6,10	30	Instrument	BD/EKOM/43 JB-03961	JB OVERRIDE SWITCH ANTI COLL. 19-07010	30,1	Shorted	30.1.1	Shorted because of moisture - Connection broken	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Effectively OEM is refering to IEC 60079-17, which in terms are giving instructions to inspect at least every 3Y. 1Y is based on analysts personal experience of the build-up of moisture in JB offshore.	1. Inspect and clean - TD	1Y
6,10	31	Instrument	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07010	31,1	Shorted	31.1.1	Shorted because of moisture - Connection broken	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	32	Instrument	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,1	False indication	32.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	32	Instrument	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,2	Broken	32.2.1	Moisture in the electronics	A									Not applicable. Covered by FM 32.1		
6,10	33	Instrument	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	33,1	False indication	33.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	33	Instrument	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	33,2	Broken	33.2.1	Moisture in the electronics	A									Not applicable covered by FM 33.1		

6,10	39	Instrument	BD/EKOM/28 07011	SWITCH PUSH BUTTON STATION FOR 19 07010	39,1	Shorted	39.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1. This failure mode had a 80,36% reliability at 265 days operating. With a MTBF of 341 days. This is prior to installing radio remotes	1. Inspect and clean - TD	1Y
6,10	40	Instrument	BD/EKOM/28 08293	SWITCH EMERG STOP CRANE 19 07010	40,1	Shorted	40.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	41	Instrument	BD/EKOM/28 LCP-07010	PANEL CONTROL. OVERHEAD CRANE 19 07010	41,1	Shorted	41.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
12,30	12	Bridge		TRAVEL WHEELS	12,2	Structural failure	12.2.1	Massive degradation to structure	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12,30	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,4	Brake not engaging	14.4.1	Wear and tear	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12,30	17	Hoist	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,2	Severe structural corrosion	17.2.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12,30	18	Hoist		UPPER BLOCK	18,2	Severe structural corrosion	18.2.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12,30	44	Runway		RUNWAY BEAMS	44,1	Severe structural corrosion	44.1.1	Lack of sufficient cross section in structureal supports	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12,30	45	Trolley		TROLLEY TRAVEL WHEELS	45,1	Severe structural corrosion	45.1.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
13,10	35	Instrument	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,1	False indication	35.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
13,10	35	Instrument	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,2	Broken	35.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD		1. Inspect and clean - TD	1Y
13,10	36	Instrument	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,1	False indication	36.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
13,10	36	Instrument	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,2	Broken	36.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD		1. Inspect and clean - TD	1Y
14,10	15	Hoist		GEARBOX MOTOR HOIST INTERMITTENT	15,1	Gearbox not rotating	15.1.1	Broken gears	A	P	Y	N	N	-	Y	-	1. Verify oil level - TD 2. Change oil - TD	Crane OEM 4Y oil change. Gear OEM 1Y oil cahnge.	2. Change oil - TD	1Y
14,10	16	Hoist		GEARBOX MOTOR HOIST MAIN	16,1	Gearbox not rotating	16.1.1	Broken gears	A	P	Y	N	N	-	Y	-	1. Verify oil level - TD 2. Change oil - TD	Verifying oil level at certain interval and change oil at another interval	1. Verify oil level - TD 2. Change oil - TD	1. 1Y 2. 4Y

14,10	19	Hoist	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,1	Broken	19.1.1	Broken because of severe missuse or deterioation	A											1. Inspect wire rope 2. Change wire rope	With reliability rate of 83,83% the wire rope should be changed every 90days. MTBF = 292d	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 3M
14,10	19	Hoist	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,2	Missing	19.2.1	Not installed	A												Not applicable. Wire rope will not go missing.		
14,10	19	Hoist	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,3	Corroded	19.3.1	Lack of lubrication	A		P	Y	N	N	-	Y	-			1. Inspect wire rope 2. Lubricate wire rope	Not applicable if change rate is every 3M.	1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M
14,10	20	Hoist		WIRE END CONNECTION OUTER	20,1	Broken	20.1.1	Broken because of severe missuse or deterioation	A		P	Y	N	N	-	Y	-			1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14,10	20	Hoist		WIRE END CONNECTION OUTER	20,2	Corroded	20.2.1	Moisture	A												Not applicable. Covered by FM 20.1		
14,10	21	Hoist		WIRE END CONNECTION	21,1	Broken	21.1.1	Broken because of severe missuse or deterioation	A		P	Y	N	N	-	Y	-			1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14,10	21	Hoist		WIRE END CONNECTION	21,2	Corroded	21.2.1	Moisture	A												Not applicable. Covered by FM 21.1		
14,10	34	Instrument	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,1	False indication	34.1.1	Age	A		P	Y	N	N	-	Y	-			1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
14,10	34	Instrument	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,2	Incorrect setting	34.2.1	Unkown	A		P	Y	N	N	-	Y	-			1. Verify limits	Verify the limits by running crane up and down. Adjust if necessary. Reliability of 80% achieved when using the interval of 140 days. MTBF = 813 days. 90 days give a reliability of 86%.	1. Verify limits	3M
14,10	37	Instrument		OVERLOAD SWITCH HOIST	37,1	False indication	37.1.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-			1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y

14,10	37	Instrument		OVERLOAD SWITCH HOIST	37,2	Incorrect setting	37.1.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Verify limits - TD	Giving the equipment history reliability will be 82,60% if this is checked every 9M. MTBF is 997	1. Verify limits - TD	9M
42,10	42	Other	BD/EKOM/19 07558	PADEYE TEST SWL 35T (FOR OT CRANE)	42,1	Overstress	42.1.1	Tear out due to loss of cross section	A		P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation - TD	1Y
3,20	3	Bridge		CABLE TRAY	3,1	Bent	3.1.1	Colliding into other structures, because of hooking	B		P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation - TD	1Y
6,10	6	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,1	Motor bearing defective	6.1.1	Insufficient lubrication	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
6,10	6	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,2	Motor cage or rotor defective	6.2.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
6,10	6	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,3	Brake not releasing	6.3.1	Worn brake	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6,10	7	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,1	Motor bearing defective	7.1.1	Insufficient lubrication	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
6,10	7	Bridge	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,2	Motor cage or rotor defective	7.2.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
6,10	7	Bridge	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,3	Brake not releasing	7.3.1	Worn brake	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6,10	8	Bridge	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	8,1	Gearbox not rotating	8.1.1	Broken gears	B		P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
6,10	9	Bridge	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	9,1	Gearbox not rotating	9.1.1	Broken gears	B		P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
6,10	10	Bridge		DRIVE PINION	10,1	Drive pinion not rotating	10.1.1	Broken theets	B		P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y

6,10	11	Bridge		DRIVE CHAIN	11,1	Drive chain broken	11.1.1	Aberration	B	P	Y	N	N	-	Y	-	1. Inspect, clean and lubricate - TD 2. Change - TD	Failure mode have a reliability of 80% if changed within 450 days or approx 1,25Y. Giving a MTBF = 1736 days. Spray on lubrication	1. Inspect, clean and lubricate - TD	1Y
6,10	12	Bridge		TRAVEL WHEELS	12,1	Deformed	12.1.1	Bearing failure	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6,10	22	Instrument	BD/EKOM/43 ZE-29556	ELEMENT POSITION REFLECTOR "A" 19 07010	22,1	Missing	22.1.1	Detached from location	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD		1. Inspect and clean - TD	3M
6,10	23	Instrument	BD/EKOM/43 ZE-29557	ELEMENT POSITION REFLECTOR "B" 19 07010	23,1	Missing	23.1.1	Detached from location	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD		1. Inspect and clean - TD	3M
6,10	26	Instrument	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,1	Shorted	26.1.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	26	Instrument	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,2	False indication	26.2.1	Age	B									See FM 26.2		
6,10	27	Instrument	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,1	Shorted	27.1.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	27	Instrument	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,2	False indication	27.2.1	Age	B									See FM 27.1		
6,10	28	Instrument	BD/EKOM/28 JB-08238	JUNCTION BOX	28,1	Shorted	28.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	29	Instrument	BD/EKOM/28 JE-07010	BOX JUNCTION OVERHEAD CRANE 19 07010	29,1	Shorted	29.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	38	Instrument	BD/EKOM/28 07010	SWITCH MAIN FOR OVERHEAD CRANE 19 07010	38,1	Shorted	38.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6,10	43	Runway		BRIDGE GEAR RACK	43,1	Broken	43.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
13,10	13	Bridge		TROLLEY GEAR RACK	13,1	Broken	13.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
13,10	45	Trolley		TROLLEY TRAVEL WHEELS	45,1	Deformed	45.1.1	Bearing failure	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
13,10	46	Trolley	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,1	Motor bearing defective	13.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
13,10	46	Trolley	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13,2	Motor cage or rotor defective	13.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y

13,10	46	Trolley	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13.3	Brake not releasing	13.3.1	Worn brake	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
13,10	47	Trolley		GEARBOX TROLLEY MOTOR	47,1	Gearbox not rotating	47.1.1	Broken gears	B		P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
13,10	48	Trolley		PINION TROLLEY DRIVE	48,1	Drive pinion not rotating	48.1.1	Broken theets	B		P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
14,10	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14.1	Motor bearing defective	14.1.1	Insufficient lubrication	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
14,10	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14.2	Motor cage or rotor defective	14.2.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
14,10	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14.3	Brake not releasing	14.3.1	Worn brake	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14,10	17	Hoist	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17.1	Corrosion in bearings	17.1.1	Water penetration in bearings.	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M
14,10	18	Hoist		UPPER BLOCK	18,1	Corrosion in bearings	18.1.1	Water penetration in bearings.	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M
2,10	2	Bridge		BUMPER	2,1	Brittle	2.1.1	Age	D/C		N	-	N	Y	N	N	N	RTF		RTF	
4,10	4	Bridge	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012	4,1	Shorted	4.1.1	Age	D/C		N	-	N	Y	N	N	N	RTF		RTF	
4,10	5	Bridge	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258	5,1	Shorted	5.1.1	Age	D/C		N	-	N	Y	N	N	N	RTF		RTF	

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	363	2	0,5	-0,366512921	5,894402834
2	395	3	0,794117647	0,457709854	5,978885765
3	265	1	0,205882353	-1,467401781	5,579729826
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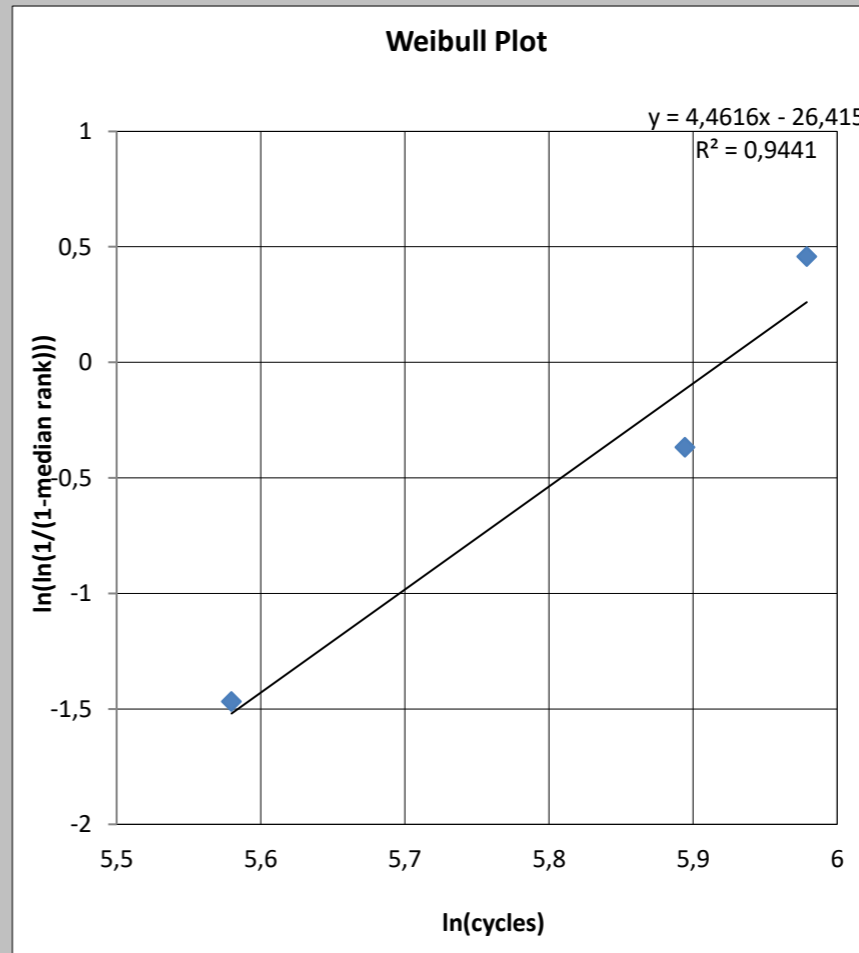
Enter the minimum number of cycles you desire the product to achieve: 265

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 4,46

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 373

Reliability at 265 cycles 80,36 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 265 cycles.

The Shape Parameter, Beta, is greater than 1 indicating that the product is experiencing normal wear out failure rate

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	59	1	0,109375	-2,155616006	4,077537444
2	172	2	0,265625	-1,175270415	5,147494477
3	280	4	0,578125	-0,147287035	5,634789603
4	642	6	0,890625	0,794336831	6,464588304
5	262	3	0,421875	-0,601543551	5,568344504
6	338	5	0,734375	0,281917795	5,823045895
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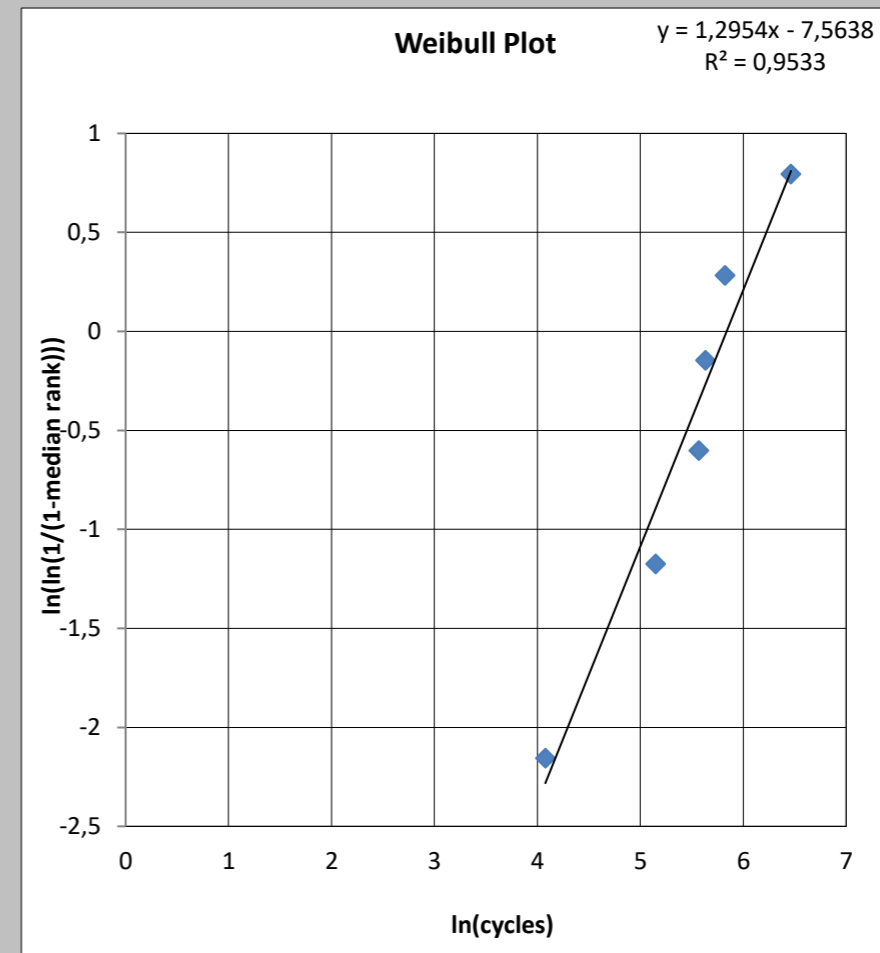
Enter the minimum number of cycles you desire the product to achieve: 90

Enter the percentage of product you wish to survive the desired number of cycles: 85 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 1,30

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 343

Reliability at 90 cycles 83,83 %



Conclusions:

The product will not meet the desired reliability of 85 percent at 90 cycles.

The Shape Parameter, Beta, is greater than 1 indicating that the product is experiencing normal wear out failure rate

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	1 365	2	0,708333333	0,208755483	7,218909708
2	265	1	0,291666667	-1,064673327	5,579729826
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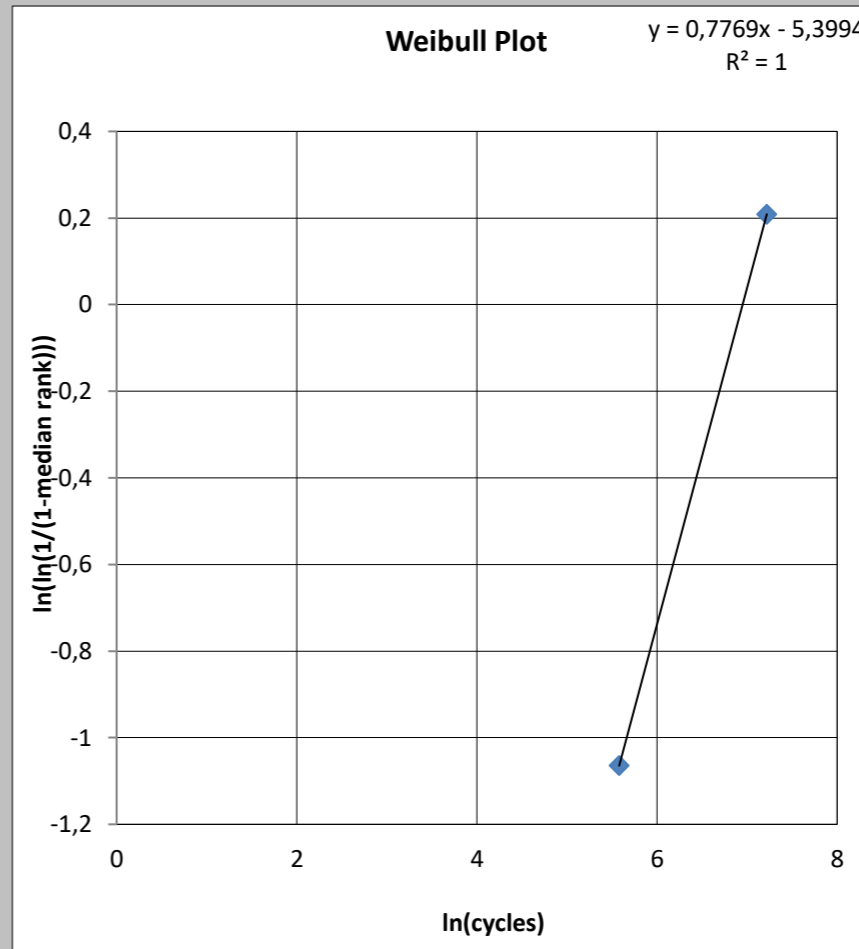
Enter the minimum number of cycles you desire the product to achieve: 90

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 0,78

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 1 043

Reliability at 90 cycles 86,16 %



Conclusions:
 The product will meet or exceed the desired reliability of 80 percent at 90 cycles.
 The Shape Parameter, Beta, is less than 1 indicating that the product is experiencing infant life failure rate

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	1 944	3	0,794117647	0,457709854	7,572502985
2	675	2	0,5	-0,366512921	6,514712691
3	371	1	0,205882353	-1,467401781	5,916202063
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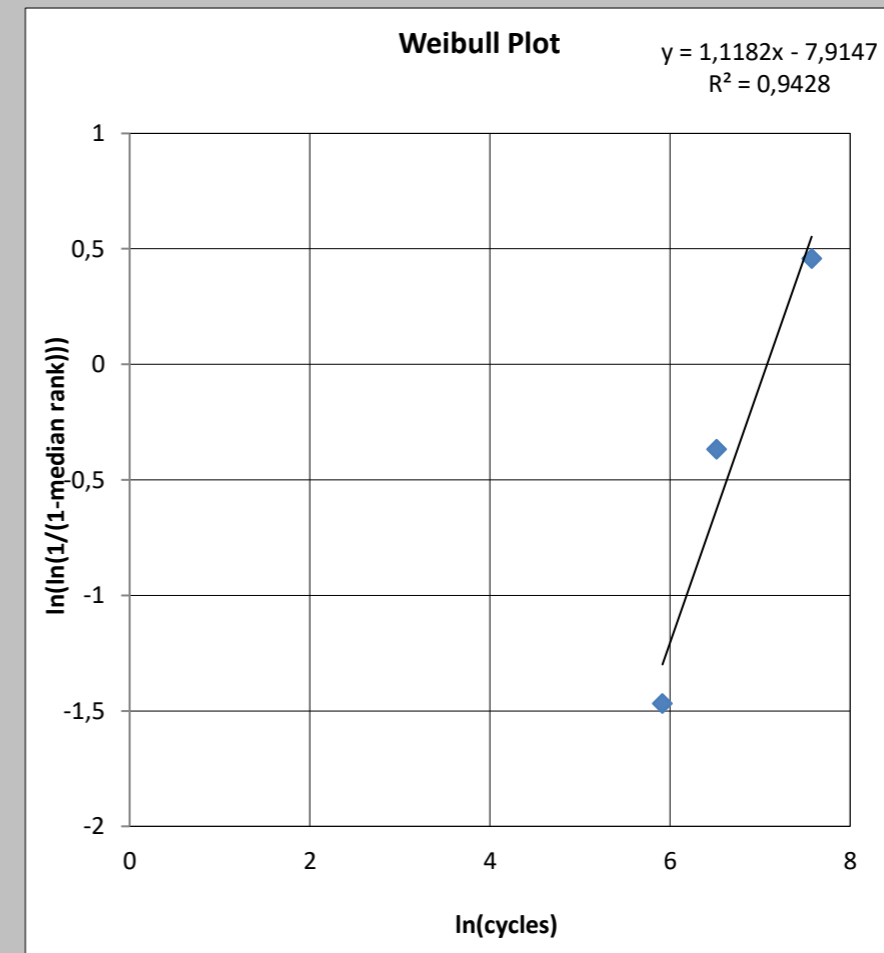
Enter the minimum number of cycles you desire the product to achieve: 270

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 1,12

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 1 186

Reliability at 270 cycles 82,60 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 270 cycles.

The Shape Parameter, Beta, is nearly equal to 1 indicating that the product is experiencing a constant failure rate

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	2 743	2	0,708333333	0,208755483	7,916807491
2	728	1	0,291666667	-1,064673327	6,590301048
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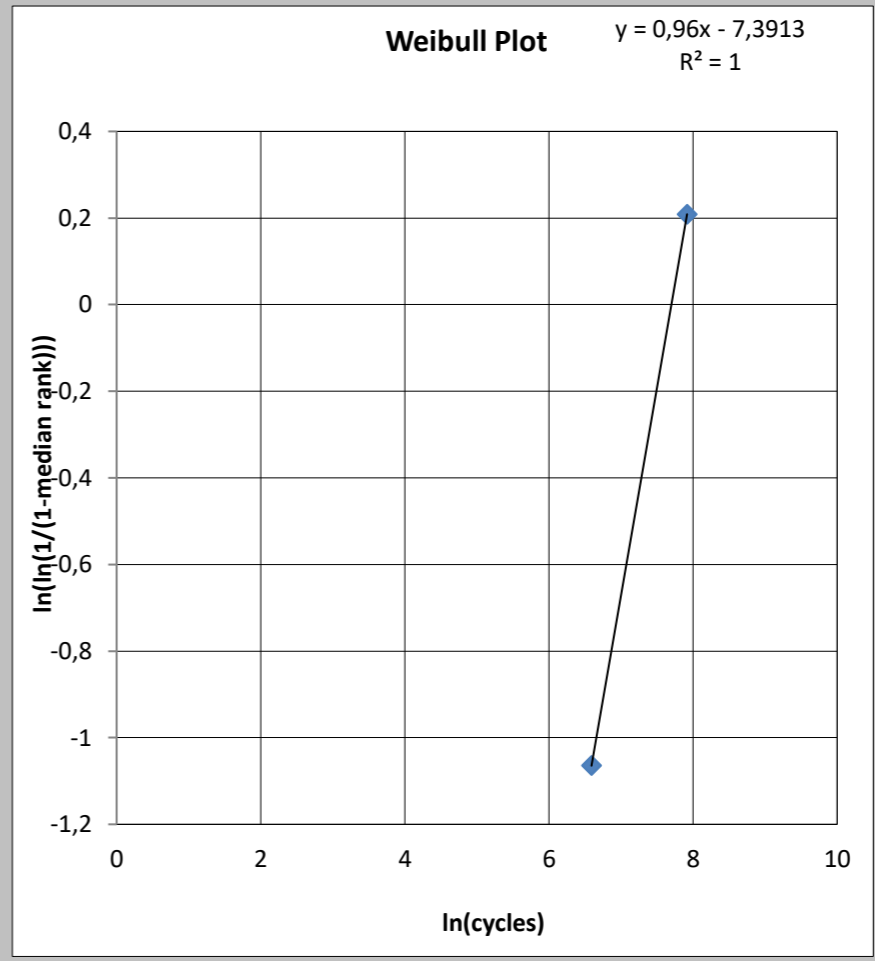
Enter the minimum number of cycles you desire the product to achieve: 450

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 0,96

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 2 207

Reliability at 450 cycles 80,47 %



Conclusions:
 The product will meet or exceed the desired reliability of 80 percent at 450 cycles.
 The Shape Parameter, Beta, is nearly equal to 1 indicating that the product is experiencing a constant failure rate

7-2 Sanity Checklist

FF#	Comp #	TAG	Component Description	FM#	Failure mode	1	2	3	4	5	6	7	8	RTF	Selection Dec	Est Freq	Comments
2,1	2		BUMPER	2,1	Brittle	N	N	N	N	N	N	N	N	RTF	RTF		
4,1	4	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012	4,1	Shorted	N	N	N	Y	N	Y	N	N	No	1. Inspect for external damage. - TD 2. Open and check internally - TD	3M/6M	OEM gives instructions to inspect for external damage every 3M and internal damage and moisture every 6M
4,1	5	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258	5,1	Shorted	N	N	N	Y	N	Y	N	N	No	1. Inspect for external damage. - TD 2. Open and check internally - TD	3M/6M	OEM gives instructions to inspect for external damage every 3M and internal damage and moisture every 6M

7-3 Task comparison

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	RCM Selection Dec.	Est Freq.	Current Task	Freq.
3,20	3	Bridge		CABLE TRAY	3,1	Bent	1. Check for wear and tear or deformation - TD	1Y	WS-19OVER30. M	6M
4,10	4	Bridge	BD/EKOM/27 23857	HEATER ELEMENT MOTOR 30 07012	4,1	Shorted	1. Inspect for external damage. - TD 2. Open and check internally - TD	3M/6M	WS-30MOTO68. E	1Y
4,10	5	Bridge	BD/EKOM/27 23858	HEATER ELEMENT MOTOR 30 07258	5,1	Shorted	1. Inspect for external damage. - TD 2. Open and check internally - TD	3M/6M	WS-30MOTO68. E	1Y
6,10	6	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
6,10	6	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
6,10	6	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	6,3	Brake not releasing	1. Inspect and clean - TD	1Y		
6,10	7	Bridge	BD/EKOM/30 07012	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
6,10	7	Bridge	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
6,10	7	Bridge	BD/EKOM/30 07258	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	7,3	Brake not releasing	1. Inspect and clean - TD	1Y		
6,10	8	Bridge	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	8,1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER45. M	4Y
6,10	9	Bridge	BD/EKOM/63 07055	GEARBOX. MOTOR TRAVELLING 30 07258	9,1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER45. M	4Y
6,10	10	Bridge		DRIVE PINION	10,1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER45. M	1Y
6,10	11	Bridge		DRIVE CHAIN	11,1	Drive chain broken	1. Inspect, clean and lubricate - TD	1Y		
12,30	12	Bridge		TRAVEL WHEELS	12,2	Structural failure	1. Inspect and clean - TD	1Y		
6,10	12	Bridge		TRAVEL WHEELS	12,1	Deformed	1. Inspect and clean - TD	1Y		
13,10	13	Bridge		TROLLEY GEAR RACK	13,1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER45. M	4Y
12,30	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,4	Brake not engaging	1. Inspect and clean - TD	1Y	WS-19OVER33. M	6M
14,10	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
14,10	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y

14,10	14	Hoist	BD/EKOM/30 07010	MOTOR HOIST. CRANE OVERHEAD 19 07010	14,3	Brake not releasing	1. Inspect and clean - TD	1Y	WS-19OVER33. M	6M
14,10	15	Hoist		GEARBOX MOTOR HOIST INTERMITTENT	15,1	Gearbox not rotating	2. Change oil - TD	1Y	WS-19OVER45. M	4Y
14,10	16	Hoist		GEARBOX MOTOR HOIST MAIN	16,1	Gearbox not rotating	1. Verify oil level - TD 2. Change oil - TD	1. 1Y 2. 4Y	WS-19OVER32. M/WS-19OVER45. M	1Y/4Y
12,30	17	Hoist	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,2	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
14,10	17	Hoist	BD/EKOM/19 02823	BLOCK DOUBLE SHEAVE WITH HOOK	17,1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M	1. WS-19OVER59. M	3M
12,30	18	Hoist		UPPER BLOCK	18,2	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
14,10	18	Hoist		UPPER BLOCK	18,1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M	1. WS-19OVER59. M	3M
14,10	19	Hoist	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,1	Broken	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 3M	1. WS-19OVER59. M	3M
14,10	19	Hoist	BD/EKOM/19 02824	WIRE 18 MM MIN BRUDD 32,9 T	19,3	Corroded	1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M	1. WS-19OVER59. M	3M
14,10	20	Hoist		WIRE END CONNECTION OUTER	20,1	Broken	1. Inspect and clean - TD	1Y	1. WS-19OVER59. M	3M
14,10	21	Hoist		WIRE END CONNECTION	21,1	Broken	1. Inspect and clean - TD	1Y	1. WS-19OVER59. M	3M
		Hoist		Drum bearings					WS-19OVER45. M	1Y
6,10	22	Instrument	BD/EKOM/43 ZE-29556	ELEMENT POSITION REFLECTOR "A" 19 07010	22,1	Missing	1. Inspect and clean - TD	3M		
6,10	23	Instrument	BD/EKOM/43 ZE-29557	ELEMENT POSITION REFLECTOR "B" 19 07010	23,1	Missing	1. Inspect and clean - TD	3M		
6,10	24	Instrument	BD/EKOM/43 ZS-29173	SWITCH LIMIT LASER 19 07010	24,1	False indication	1. Inspect and clean - TD	3M		
6,10	25	Instrument	BD/EKOM/43 ZS-29174	SWITCH LIMIT LASER 19 07010	25,1	False indication	1. Inspect and clean - TD	3M		
6,10	26	Instrument	BD/EKOM/43 TY-07012	ELEM TEMP CONVERSION FOR MOTOR 30 07012	26,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	27	Instrument	BD/EKOM/43 TY-07258	ELEM TEMPE CONVERSION FOR MOTOR 30 07258	27,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	28	Instrument	BD/EKOM/28 JB-08238	JUNCTION BOX	28,1	Shorted	1. Inspect and clean - TD	1Y		

6,10	29	Instrument	BD/EKOM/28 JE-07010	BOX JUNCTION OVERHEAD CRANE 19 07010	29,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	30	Instrument	BD/EKOM/43 JB-03961	JB OVERRIDE SWITCH ANTI COLL. 19-07010	30,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	31	Instrument	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07010	31,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	32	Instrument	BD/EKOM/43 ZS-01854	SWITCH POS TRAVEL OVERH CRANE 19 07010	32,1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
6,10	33	Instrument	BD/EKOM/43 ZS-01855	SWITCH POS TRAVEL OVERH CRANE 19 07010	33,1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
14,10	34	Instrument	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
14,10	34	Instrument	BD/EKOM/43 ZS-01850	SW LIMIT HOOK POS OVERH CRANE 19 07010	34,2	Incorrect setting	1. Verify limits	3M	WS-19OVER30.M	6M
13,10	35	Instrument	BD/EKOM/43 ZS-01852	SWITCH POS TROLLY OVERH CRANE 19 07010	35,1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
13,10	36	Instrument	BD/EKOM/43 ZS-01853	SWITCH POS TROLLY OVERH CRANE 19 07010	36,1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
14,10	37	Instrument		OVERLOAD SWITCH HOIST	37,1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER33.M	6M
14,10	37	Instrument		OVERLOAD SWITCH HOIST	37,2	Incorrect setting	1. Verify limits - TD	9M	WS-19OVER33.M	6M
6,10	38	Instrument	BD/EKOM/28 07010	SWITCH MAIN FOR OVERHEAD CRANE 19 07010	38,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	39	Instrument	BD/EKOM/28 07011	SWITCH PUSH BUTTON STATION FOR 19 07010	39,1	Shorted	1. Inspect and clean - TD	1Y	WS-30MOTO68.E	1Y
6,10	40	Instrument	BD/EKOM/28 08293	SWITCH EMERG STOP CRANE 19 07010	40,1	Shorted	1. Inspect and clean - TD	1Y		
6,10	41	Instrument	BD/EKOM/28 LCP-07010	PANEL CONTROL. OVERHEAD CRANE 19 07010	41,1	Shorted	1. Inspect and clean - TD	1Y		
42,10	42	Other	BD/EKOM/19 07558	PADEYE TEST SWL 35T (FOR OT CRANE)	42,1	Overstress	1. Check for wear and tear or deformation - TD	1Y		
6,10	43	Runway		BRIDGE GEAR RACK	43,1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER30.M	6M
12,30	44	Runway		RUNWAY BEAMS	44,1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
12,30	45	Trolley		TROLLEY TRAVEL WHEELS	45,1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M

13,10	45	Trolley		TROLLEY TRAVEL WHEELS	45,1	Deformed	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
13,10	46	Trolley	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
13,10	46	Trolley	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68.E	1Y
13,10	46	Trolley	BD/EKOM/30 07011	MOTOR TROLLEY. CRANE OVERHEAD 19 07010	13.3	Brake not releasing	1. Inspect and clean - TD	1Y		
13,10	47	Trolley		GEARBOX TROLLEY MOTOR	47,1	Gearbox not rotating	1. Change oil - TD	4Y		

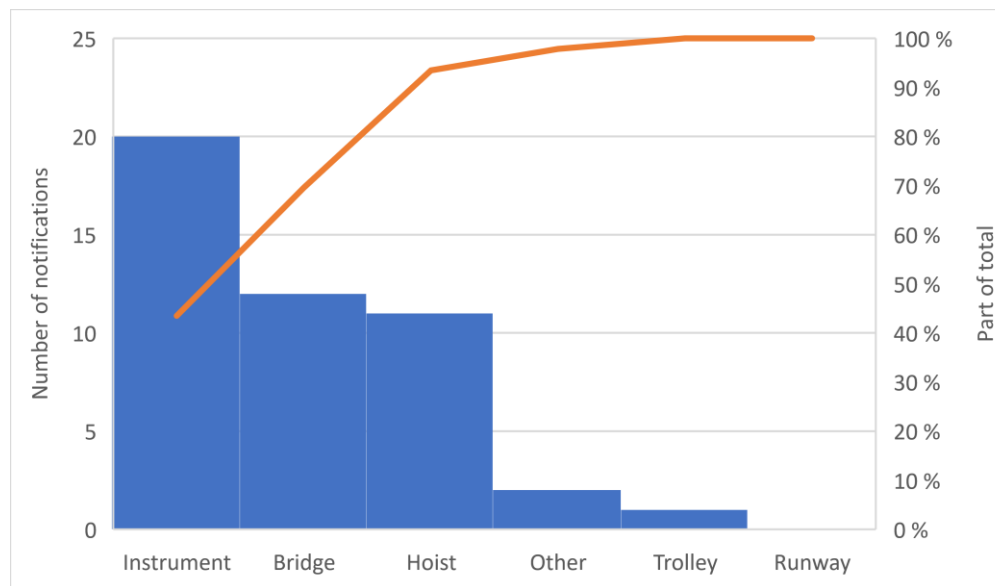
Complete Analysis

TAG NO. 07015

1-1 Pareto pre-modification

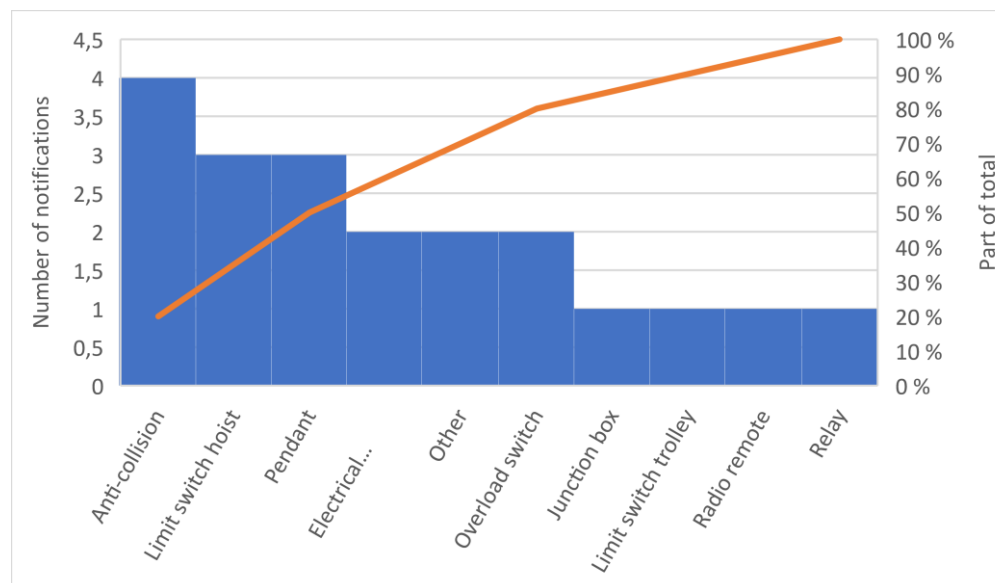
Overall

Bridge	12	0,26087
Hoist	11	0,23913
Instrument	20	0,434783
Other	2	0,043478
Runway	0	0
Trolley	1	0,021739
Totalt minus kansellert	46	
Kansellert	16	
Totalt	62	
Opptelling fra Notifikasjoner	62	



Instrument

Anti-collision	4	0,2
Electrical protection devices	2	0,1
Junction box	1	0,05
Limit switch hoist	3	0,15
Limit switch trolley	1	0,05
Other	2	0,1
Overload switch	2	0,1
Pendant	3	0,15
Radio remote	1	0,05
Relay	1	0,05



Bridge

Crane drive

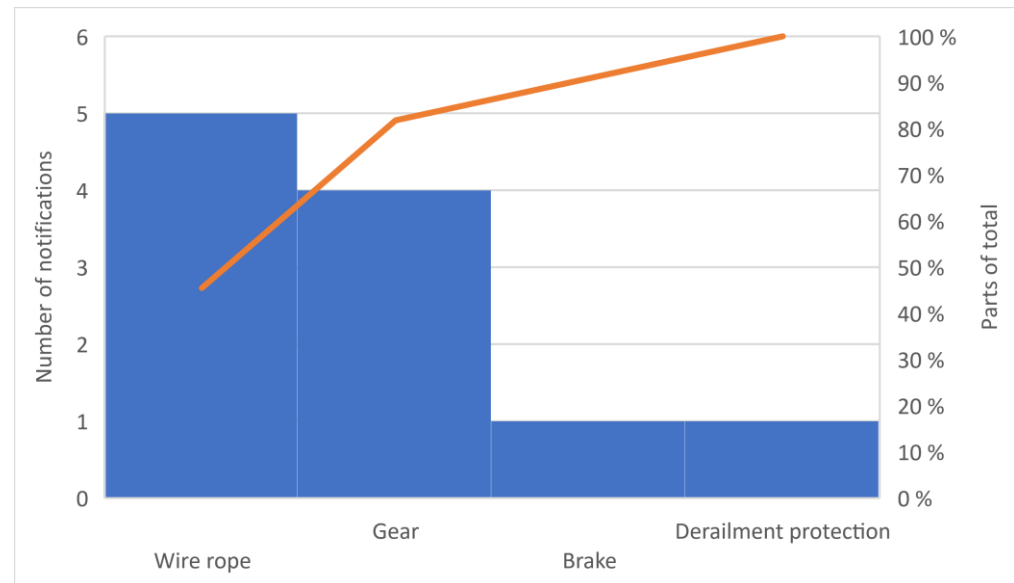
12
12 100



Hoist

Brake
Derailment protection
Gear
Wire rope

11
1 0,090909
1 0,090909
4 0,363636
5 0,454545



Priority

Priority E

Priority 1

Priority 2

Priority 3

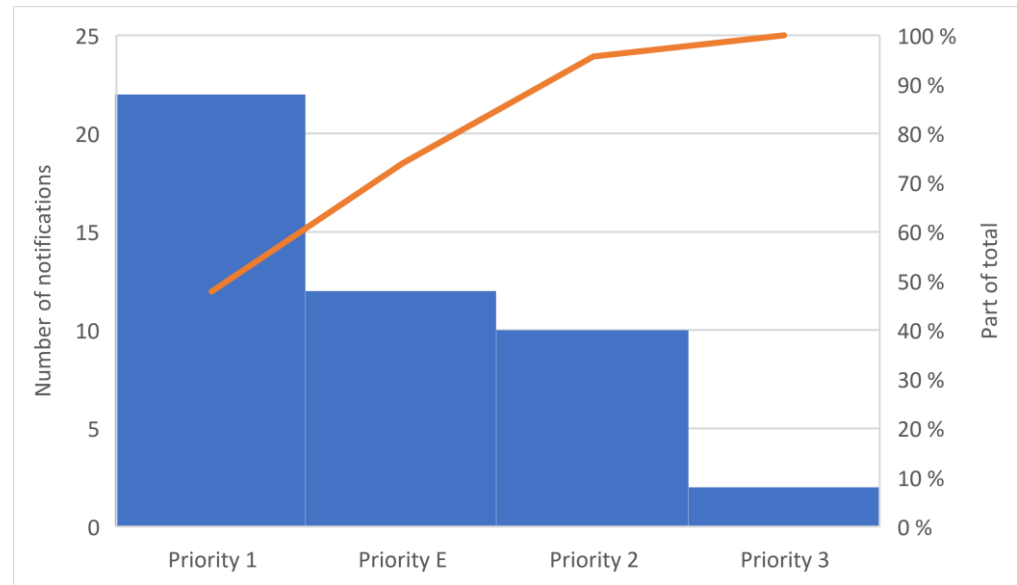
46

12 0,26087

22 0,478261

10 0,217391

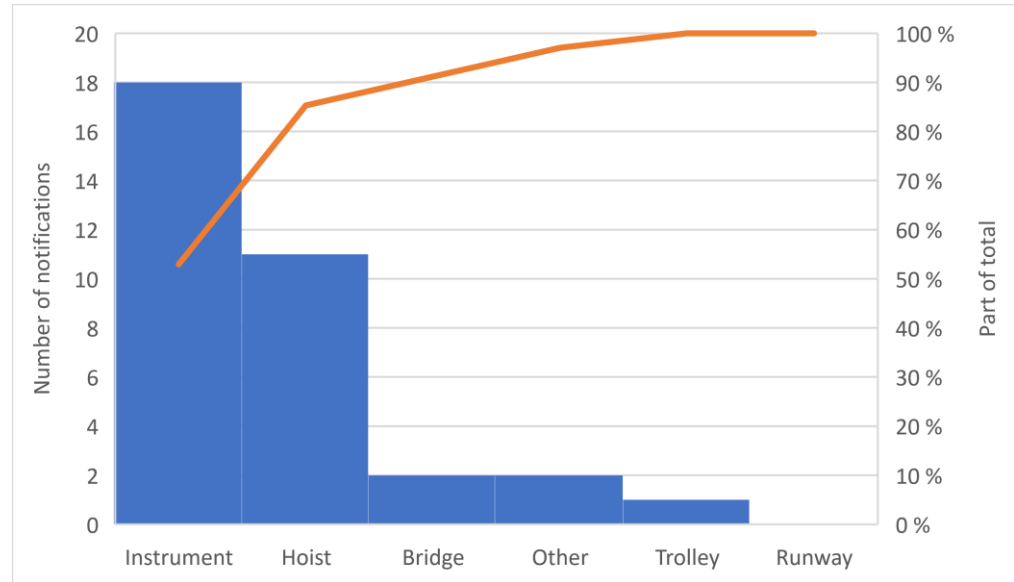
2 0,043478



1-2 Pareto after modification

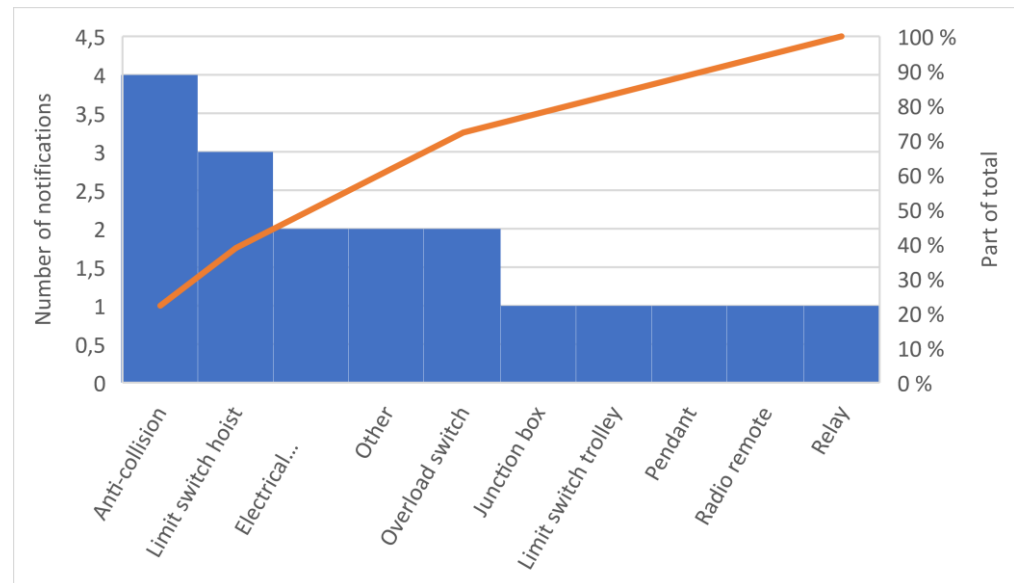
Overall

Bridge	2	0,058824
Hoist	11	0,323529
Instrument	18	0,529412
Other	2	0,058824
Runway	0	0
Trolley	1	0,029412
Totalt minus kansellert	34	
Kansellert	16	
Totalt	50	
Opptelling fra Notifikasjoner	62	



Instrument

Anti-collision	4	0,222222
Electrical protection devices	2	0,111111
Junction box	1	0,055556
Limit switch hoist	3	0,166667
Limit switch trolley	1	0,055556
Other	2	0,111111
Overload switch	2	0,111111
Pendant	1	0,055556
Radio remote	1	0,055556
Relay	1	0,055556



Bridge

Crane drive

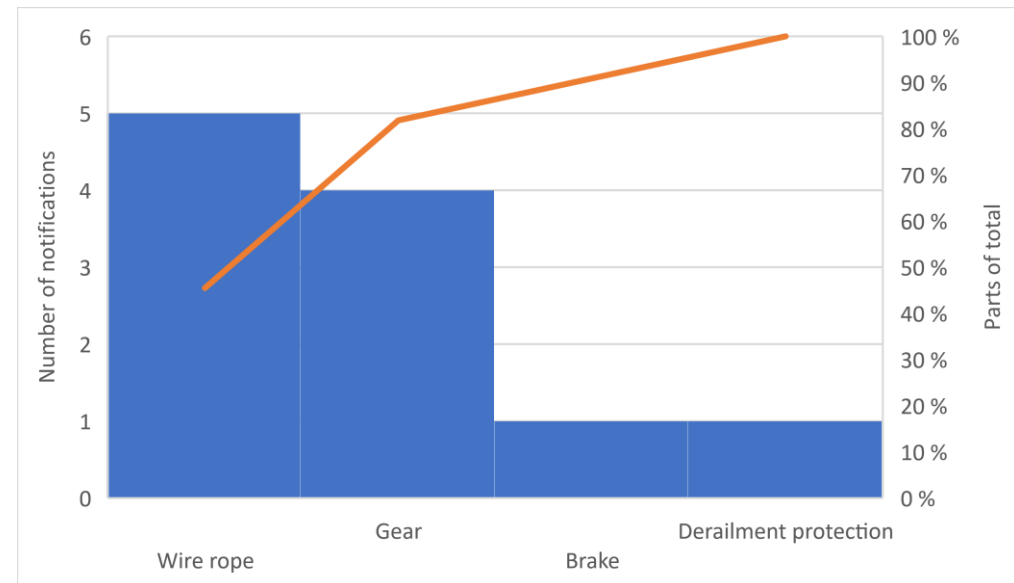
2
2 100



Hoist

Brake
Derailment protection
Gear
Wire rope

11
1 0,090909
1 0,090909
4 0,363636
5 0,454545



Priority

Priority E

Priority 1

Priority 2

Priority 3

46

12 0,26087

22 0,478261

10 0,217391

2 0,043478



RCM – Systems analysis

Step 2-1:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Overview	System ID:	BD/EKOM/840/19 07015
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07015	Date:	07.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Major Equipment Included:

Bridge:

- Girder main assembly – P655-101
- Gearbox traveling motors E/W – KU A B0/A i=62,9 IEC AD 100
- Traveling motors E/W – HB37 100LA 4 B5 3F 690V S/60 2,2kW
- Travelling wheels – P30-122
- Cable tray arrangement – P655-104
- Drive pinions – L43-4-05 U049
- Chain RS DIN8188 Offshore – 16B-1 – 1,5m

Hoist:

- Motor hoist PB35 200L4/12 EExdeIIBT3 690/60Hz – 13kW/4,3kW-B5/B3-IP66/56
- Gear planet flange Mount B3 – Adapter for IEC 200 motor – EM1045/MR1/6,3
- Gearbox assembly – C655-10201
- Wire rope Ø18mm MBL 32,9T
- Lower block – B59-137
- Upper block – B59-139

Instrument:

- Anti-collision – E3Z
- Radio remote – HBC FST 735-09-1315-C
- Limit switches – 1S5, 1S6, 2S5, 2S6 – NCN20+U1+NO Pepperl & Fuchs
- Rotary limit switch - 3S5 – 125 BM492, B5 Stromag
- Overload switch – 3S9 – ZS 336 – 11Z Schmersal

Runway:

- Runway beams
- Runway bridge travel racks

Trolley:

- Motor travel DB35 90L4-EExdeIIBT3-B5-IP66/IP56 – 1,30kW-690V/60Hz – B5
- Gear, Angle I=99,5 – Med utg. aksel – A503 UR 99,5 P90
- Travelling pinions – L43-4-023 (U049)/(U051)
- Travelling Wheels – B30-119

Primary Physical Boundaries

Start with:

Main electrical supply 3x690V 60Hz – FROM: 28-00002-05B
Supports for runway beams

Terminate with:

Lifted load. Attached in crane hook.

Caveats:

N/A

RCM – Systems analysis

Step 2-2:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Details	System ID:	BD/EKOM/840/19 07015
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07015	Date:	07.04.2018
Subsystem:			
Analyst	Øystein Refsland Andreassen		

Type	Bounding System	Interface Location	Ref. Drawing
IN (Electrical)	Instrument	28-00002-05B	E900-11915-E-00076
IN (Structural support)	Runway	W30	E900-11915-M-0006
OUT (Load)	Hoist	W30	E900-11915-M-0006

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07015
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07015	Date:	07.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Functional Description/Key Parameters

The Electrical Overhead Travelling Cranes are of underslung duobox special design for Ekofisk Platform 2/4M module W30. Both cranes are travelling on the same runway beams in north/south directions. Radio remote operates the cranes.

Main girders are made as box of plates and the end carriages are made of steel plates.

Cranes are made for Zone 1 hazardous area, All el. Equipment is designed for Zone 1 and according to DNV, NPD, ATEX and FEM rules.

The crane is for offshore installations with ambient temperature - 20°C.

Main data:

Capacity: 25T

Span: 17000 mm

Height of lift: 9,5m

Hoisting speed: 2,4 / 0,6m/min

Trolley speed: 6 m/min

Crane speed: 6 m/min

Power Supply: 690V / 60Hz

Heel: Max. 1°

Runway beams: HE550M based on max 5m between supports

Crane bridge:

The crane bridge is running on runway beams under flanges with eight (8) travel wheels. Four of these travel wheels are single flange type and mounted on one of the end carriage to obtain the horizontal travel guiding. Crane drive is equipped with explosion proof single speed electric motors with fail safe brakes through gear and pinion with cross shaft. Limit switches are installed on the crane in addition to heavy duty bumpers in each end of the runway beams. Since the two cranes are travelling on the same runway beam the cranes are equipped with anti-collision proximity switch and actuator between the two cranes in addition to bumpers. Later it was added anti-collision measures by optical sensors as well.

Hoist machinery:

Crane is equipped with electrical wire hoist with four wire falls. The hoist motor is two speed explosion proof design with fail safe brake. Overload switch and limit for top and bottom positions are included. Wire drum is grooved to ensure correct wire spooling on drum. Wire rope are galvanized and of non-rotating type.

Trolley:

The trolley is running on rails 60x60mm situated on the top of main girders with six (6) travel wheels along duo-box main girder. Trolley is also equipped with four off guide rollers against rail on top of one main girder. Trolley drive is consisting of explosion proof single speed electric motor and fail-safe brake through gear and pinions with cross shaft. Limit switches are installed on the crane bridge in addition to heavy duty bumpers in each end of the crane.

Redundancy Features

None.

Protection Features

- Limit switches bridge travel
- Anti-collision
- Overload switch

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07015
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07015	Date:	07.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

- Limit switch for hoist
- Limit switch for trolley
- Emergency stop
- Fail safe brakes

Key Control Features

Radio remote is utilized as main measure of control.

RCM – Systems analysis

Step 3-2:	System Description/FBD	Plant ID:	EKOM
Information:	Functional Block Diagram	System ID:	BD/EKOM/840/19 07015
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07015	Date:	07.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

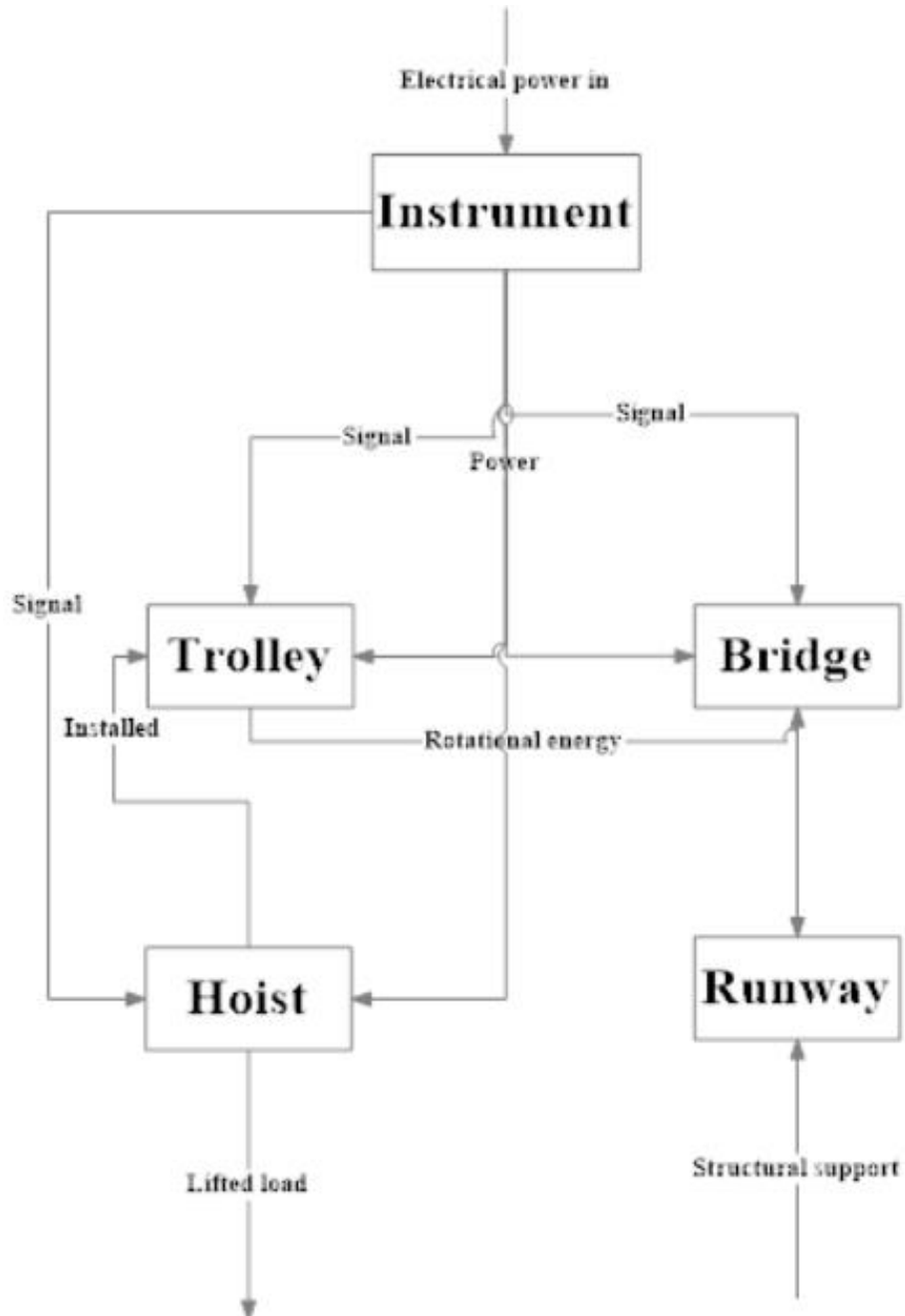


Figure 1 – Functional block diagram

RCM – Systems analysis

Step 3-3:	System Description/FBD	Plant ID:	EKOM
Information:	IN/OUT Interfaces	System ID:	BD/EKOM/840/19 07015
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 25T TAG: 07015	Date:	07.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Type	Bounding system	Interface location	Ref. drawing
IN (690V)	Instrument	28-00002-05B	E900-11915-E-00076
IN (Structural)	Runway	W30	E900-11915-M-0006
OUT (Energy)	Hoist	W30	E900-11915-M-0006

3-4 System Work Breakdown Structure

No #	TAG No.	Description	System	Sub-system	Type (Instrument only)	Qty	Dwg or ref
1	BD/EKOM/840/19 07015	CRANE OVERHEAD TRAVELLING 25 T NORTH	All	-		1	E900-11915-M-00006-001
2		BUMPER	Bridge	Bumper		4	E900-11915-M-00037-001
3		CABLE TRAY	Bridge	Cable tray		1	E900-11915-M-00037-001
4	BD/EKOM/27 23859	HEATER ELEMENT MOTOR 30 07017	Bridge	Crane drive		1	EKOM-VA-E-00008-001
5	BD/EKOM/27 23860	HEATER ELEMENT MOTOR 30 07259	Bridge	Crane drive		1	EKOM-VA-E-00008-001
6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07010	Bridge	Crane drive		1	EKOM-VA-E-00008-001
7	BD/EKOM/30 07259	MOTOR TRAVEL W. CRANE OVERHEAD. 19 07010	Bridge	Crane drive		1	EKOM-VA-E-00008-001
8	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	Bridge	Crane drive		1	EKOM-VA-E-00009-001
9	BD/EKOM/63 07058	GEARBOX. MOTOR TRAVELLING 30 07017	Bridge	Crane drive		1	EKOM-VA-E-00009-001
10		DRIVE PINION	Bridge	Crane drive		2	E900-11915-M-00037-004
11		DRIVE CHAIN	Bridge	Crane drive		2	EKOM-VA-E-00008-001
12		TRAVEL WHEELS	Bridge	Travel wheels		8	E900-11915-M-00037-001
13		TROLLEY GEAR RACK	Bridge	Trolley gear rack		2	E900-11915-M-00037-001
14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	Hoist	Hoist drive		1	E900-11915-M-00037-002
15		GEARBOX MOTOR HOIST INTERMITTENT	Hoist	Hoist drive		1	E900-11915-M-00037-002
16		GEARBOX MOTOR HOIST MAIN	Hoist	Hoist drive		1	E900-11915-M-00037-002
49		DRUM BEARINGS	Hoist	Hoist drive		2	E900-11915-M-00037-002
17	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	Hoist	Lower block		1	E900-11915-M-00037-002
18		UPPER BLOCK	Hoist	Upper block		1	E900-11915-M-00037-002
19	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	Hoist	Wire rope		1	E900-11915-M-00037-002
20		WIRE END CONNECTION OUTER	Hoist	Wire rope		1	E900-11915-M-00037-002
21		WIRE END CONNECTION	Hoist	Wire rope clamp		1	E900-11915-M-00037-002
22	BD/EKOM/43 ZE-29558	ELEMENT POSITION REFLECTOR "A" 19 07015	Instrument	Anti-collision		1	EKOM-VA-E-00101-001
23	BD/EKOM/43 ZE-29559	ELEMENT POSITION REFLECTOR "B" 19 07015	Instrument	Anti-collision		1	EKOM-VA-E-00101-001
24	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	Instrument	Anti-collision	Protection	1	EKOM-VA-E-00101-001
25	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	Instrument	Anti-collision	Protection	1	EKOM-VA-E-00101-001
26	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	Instrument	Electrical protection devices	Protection	1	EKOM-VA-E-00008-001
27	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	Instrument	Electrical protection devices	Protection	1	EKOM-VA-E-00008-001
29	BD/EKOM/28 JE-07015	BOX JUNCTION OVERHEAD CRANE 19 07015	Instrument	Junction box		1	EKOM-VA-E-00101-001
30	BD/EKOM/43 JB-03962	JB OVERRIDE SWITCH ANTI COLL. 19-07015	Instrument	Junction box	Control	1	EKOM-VA-E-00101-001
31	BD/EKOM/43 JB-03972	JUNCTION BOX EX ANTI COLLISION 19-07015	Instrument	Junction box		1	EKOM-VA-E-00101-001
28		JUNCTION BOX	Instrument	Junction box		1	EKOM-VA-E-00101-001
32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00076-001
33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00076-001
34	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	Instrument	Limit switch hoist	Protection	1	E900-11915-E-00076-001
35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00076-001
36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00076-001
37		OVERLOAD SWITCH HOIST	Instrument	Overload switch hoist	Protection	1	E900-11915-E-00076-001
38	BD/EKOM/28 07015	SWITCH MAIN FOR OVERHEAD CRANE 19 07015	Instrument	Pennant	Control	1	E900-11915-E-00076-001
39	BD/EKOM/28 07016	SWITCH PUSH BUTTON STATION FOR 19 07015	Instrument	Pennant	Control	1	E900-11915-E-00076-001

40	BD/EKOM/28 08294	SWITCH EMERG STOP CRANE 19 0701	Instrument	Pennant	Control	1	EKOM-VA-E-00101-001
41	BD/EKOM/28 LCP-07015	PANEL CONTROL. OVERHEAD CRANE 19 07015	Instrument	Radio remote	Control	1	EKOM-VA-E-00101-001
43		BRIDGE GEAR RACK	Runway	Runway beams		2	E900-11915-M-00006-001
44		RUNWAY BEAMS	Runway	Runway beams		2	E900-11915-M-00006-001
45		TROLLEY TRAVEL WHEELS	Trolley	Travelling wheels		6	E900-11915-M-00037-002
46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	Trolley	Trolley drive		1	E900-11915-M-00037-002
47		GEARBOX TROLLEY MOTOR	Trolley	Trolley drive		1	E900-11915-M-00037-002

3-5 Equipment history

Date	TAG No.	Description	System	Sub-system	Failure mode	Failure Cause
23.04.2006		Crane drive axle	Bridge	Crane drive	Damaged	Collision with drilling riser M20
12.05.2006		Crane drive axle	Bridge	Crane drive	Dry	Missing lubrication
15.05.2006		Crane drive axle	Bridge	Crane drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit
18.11.2006		Crane drive axle	Bridge	Crane drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit
19.01.2007		Crane drive axle, broken locking ring	Bridge	Crane drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit
25.01.2007		Motor protection device	Instrument	Electrical protection devices	Broken	Unknown
30.04.2007		Low speed relay	Instrument	Relay	Broken	Unknown - Moisture?
12.05.2007		Earth failure relay	Instrument	Electrical protection devices	Broken	Unknown - Moisture?
19.06.2007		Crane drive axle	Bridge	Crane drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit
21.09.2007		Crane drive axle	Bridge	Crane drive	Defective	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit
25.02.2008		Crane drive axle	Bridge	Crane drive	Damaged	The cranes were built with one drive motor for bridge travel. This is causing the crane to skew a little bit
11.03.2008		Electrical protection device	Instrument	Electrical protection devices	Damaged	Unknown
05.05.2008		Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error?
09.05.2008		Pendant support wire	Instrument	Pendant	Damaged	Unknown
08.06.2008	BD/EKOM/28 07016	Pendant	Instrument	Pendant	Damaged	Unknown
21.06.2008		Crane drive axle	Bridge	Crane drive	Damaged	Collsion with drilling riser
21.01.2009		Crane drive axle	Bridge	Crane drive	Damaged	Uknown
15.02.2009	BD/EKOM/19 02822	Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error?
11.03.2010	BD/EKOM/19 02822	Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error?
05.12.2010	BD/EKOM/30 07016	Electrical motor	Trolley	Trolley drive	Failed	Uknown - Environment?
25.04.2011		Gearbox main	Hoist	Gear	Damaged	Unknown
25.04.2011		Gearbox main	Hoist	Gear	Wrong oil level	Unknown
18.07.2011	BD/EKOM/43 ZS-29172	Laser anti-collision	Instrument	Anti-collision	Failed	Unknown
18.10.2011		Panel control	Instrument	Radio remote	Damaged	Unknown
18.12.2011	BD/EKOM/43 ZS-01856	Limit switch hoist	Instrument	Limit switch hoist	Incorrect	Unknown
14.02.2012		Crane drive support plate	Bridge	Crane drive	Missing	Unknown - Human error?
15.02.2012		Laser anti-collision	Instrument	Anti-collision	Failed	Unknown - Moisture?
19.03.2012		Laser anti-collision	Instrument	Anti-collision	Flucutates	Unknown - Moisture?
19.03.2012		Drive chain	Bridge	Crane drive	Slack	Unknown
04.06.2012	BD/EKOM/43 ZS-01856	Limit switch hoist	Instrument	Limit switch hoist	Incorrect	Unknown
17.10.2013	BD/EKOM/19 02822	Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error?
13.03.2014	BD/EKOM/19 02822	Wire rope	Hoist	Wire rope	Damaged	Unknown - Human error?
27.08.2014		Derailment protection	Hoist	Derailment protection	Loose items	Unknown - Bad securing?
02.09.2014		Limit switch hoist	Instrument	Limit switch hoist	Incorrect	Unknown
05.12.2014	BD/EKOM/30 07015	Hoist brake	Hoist	Brake	Incorrect	Unknown
24.12.2014		Relay	Instrument	Relay	Defective	Unknown
12.01.2015	BD/EKOM/43 ZS-01859	Limit switch trolley	Instrument	Limit switch trolley	Defective	Unknown
08.03.2015		Cover brake	Instrument	Other	Stuck	Unknown
08.03.2015		Drive chain	Bridge	Crane drive	Worn	Unknown
08.03.2015		Overload switch	Instrument	Overload switch	Defective	Unknown
12.10.2015		Laser anti-collision	Instrument	Anti-collision	Defective	Unknown
02.12.2015		Gearbox main	Hoist	Gear	Leak	Unknown
02.12.2015		Gearbox main	Hoist	Gear	Wrong oil level	Unknown

14.07.2016		Junction box	Instrument	Junction box	Defective bolt	Unknown - Environment?
13.03.2017	BD/EKOM/28 08294	Emergency stop	Instrument	Pendant	Wrong color	Unknown - Human error?

4 - Functional failures

Function #	FF #	Function/Functional failure
2		Dampen and mitigate collision if needed
	2.1	No damping of bridge
3		Carry the cables when the trolley is moving
	3.1	Cables fall off
	3.2	Cable tray collides with other structure
4/5		Heat the motor housing to prevent moisture inside housing
	4.1	No heating
	4.2	Overheating
6/7		Transmit rotational forces through gearbox, drive chain and pinion in order to move bridge
	6.1	Bridge stationary
8/9		Transmit rotational forces from motor to drive chain in order to move bridge
	6.1	Bridge stationary
10		Transmit rotational forces from drive chain in order to move bridge
	6.1	Bridge stationary
11		Transmit rotational forces from gearbox in order to move bridge
	6.1	Bridge stationary
12		Support bridge on runway and move bridge smooth
	6.1	Bridge stationary
	12.3	Load falling
13		Enable smooth movement of the trolley
	13.1	Trolley stationary
14		Moving or hold the hoist drum in order to lift a load
	14.1	Hook stationary
	12.3	Load falling
15		Transmit rotational forces from motor to main gearbox
	14.1	Hook stationary
	12.3	Load falling
16		Transmit rotational forces from intermittent gearbox to drum
	14.1	Hook stationary
	12.3	Load falling
17		Lifting load by hook, wire rope running through sheave wheels
	14.1	Hook stationary
	17.3	Hook swivel not moving
18		Guide wire rope
	14.1	Hook stationary
	12.3	Load falling
19		Move the hook and load up and down
	14.1	Hook stationary
	12.3	Load falling
20		Hold the dead end of the wire rope
	14.1	Hook stationary
	12.3	Load falling
21		Hold the dead end of the wire rope on the drum into position
	14.1	Hook stationary
	12.3	Load falling
22		Reflect the optical beam from anti-collision North side of crane bridge
	6.1	No reflection of optical beam (Crane bridge not moving north) - Bridge stationary
23		Reflect the optical beam from anti-collision South side of crane bridge
	6.1	No reflection of optical beam (Crane bridge not moving south) - Bridge stationary
24		Send out optical beam for anti-collision South side of crane bridge
	6.1	Activated when there is no obstacle (Crane bridge not moving south) - Bridge stationary

	3.2	Not activated when there is a obstacle (Crane colliding)
25		Send out optical beam for anti-collision North side of crane bridge
	6.1	Activated when there is no obstacle (Crane bridge not moving north) - Bridge stationary
	3.2	Not activated when there is a obstacle (Crane colliding)
26		Alert the control system if motor for bridge travelling east have a temperatur over a given threshold
	6.1	No feedback from termistor (Bridge stationary)
	6.1	Unvalid feedback from termistor (Bridge stationary)
27		Alert the control system if motor for bridge travelling west have a temperatur over a given threshold
	6.1	No feedback from termistor (Bridge stationary)
	6.1	Unvalid feedback from termistor (Bridge stationary)
28		Bridge crane drive west - Hold electrical connections
	6.1	No connection through junction box (Bridge stationary)
29		Bridge crane drive east - Hold electrical connections
	6.1	No connection through junction box (Bridge stationary)
30		Override anti-collision protection system
	6.1	Not possible to override anti-collision - Bridge stationary
	3.2	Override anti-collision system when not activated - Collision
31		Anti-collision system - Hold electrical connections
	6.1	No connection through junction box (Bridge not moving north)
	6.1	No connection through junction box (Bridge not moving south)
32		Prevent the crane from moving into the other crane
	6.1	Bridge not moving north
	3.2	Crane collision
33		Prevent the crane from moving into the buffer
	6.1	Bridge not moving south
	3.2	Crane touching the buffer south buffer and continue running south
34		Prevent the hook from been pull into the upper sheave or drum, and prevent the hook from touching the floor
	14.1	Hook stationary
	34.2	Hook moving into sheave or drum
	34.3	Hook touching the floor and wire going slack
35		Prevent the trolley from running into the west buffer
	13.1	Trolley not moving west
	3.2	Trolley touching the west buffer and continue running west
36		Prevent the trolley from running into the east buffer
	13.1	Trolley not moving east
	3.2	Trolley touching the east buffer and continue running east
37		Prevent overloading of hoist
	14.1	Hoist not lifting at all
	37.2	Hoist not lifting sufficient load (Insufficient capacity)
	37.3	Hoist overloaded
38		Powering the crane
	6.1	Crane does not get power
	38.2	Power will not be disconnected (Crane will not stop)
39		Operate the crane functions when radio control is disconnected (emergency operation)
	6.1	Crane bridge stationary
	13.1	Trolley stationary
	14.1	Hook stationary
	39.10	Crane stuck in high speed
	39.11	Crane stuck in low speed
	38.2	Crane will not stop
	6.1	Crane will not reset (All functions stationary)
40		Emergency stop all crane functions

	6.1	Crane not working
	38.2	Crane not stopping when emergency stop is activated
41		Operate the crane functions
	6.1	Crane bridge stationary
	13.1	Trolley stationary
	14.1	Hook stationary
	38.2	Crane will not stop
	6.1	Crane will not reset (All functions stationary)
43		Enable smooth movement of the bridge
	6.1	Bridge stationary
44		Support the bridge
	12.3	Bridge falls down - Load falling
45		Support trolley on bridge and move trolley smooth
	13.1	Trolley stationary
	12.3	Load falling
46		Transmit rotational forces through gearbox, drive chain and pinion in order to move the trolley
	13.1	Trolley stationary
47		Transmit rotational forces from motor to pinion in order to move the trolley
	13.1	Trolley stationary
48		Transmit rotational forces from gearbox to gear rack in order to move the trolley
	13.1	Trolley stationary
49		Center the drum
	14.1	Not able to lift load

5-1 Equipment-functional failure matrix

TAG No.	Component description	Functional failures	2.1 - No Damping of bridge	3.1 Cables fall off	3.2 Collision with other structure	4.1 No heating	4.2 Overheating	6.1 Bridge stationary	12.3 Load falling	13.1 Trolley stationary	14.1 Hook stationary	34.3 Hook pulled into drum or sheave	34.4 Slack wire rope	37.2 Insufficient capacity
2	BUMPER	X												
3	CABLE TRAY		3.2	X										
4	BD/EKOM/27 23857 HEATER ELEMENT MOTOR 30 07017				X	4.1								
5	BD/EKOM/27 23858 HEATER ELEMENT MOTOR 30 07259				X	4.1								
6	BD/EKOM/30 07012 MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015						X							
7	BD/EKOM/30 07258 MOTOR TRAVEL W. CRANE OVERHEAD. 19 07015						X							
8	BD/EKOM/63 07055 GEARBOX. MOTOR TRAVELLING 30 07259						X							
9	BD/EKOM/63 07056 GEARBOX. MOTOR TRAVELLING 30 07017						X							
10	DRIVE PINION						X							
11	DRIVE CHAIN						X							
12	TRAVEL WHEELS						X	X						
13	TROLLEY GEAR RACK								X					
14	BD/EKOM/30 07010 MOTOR HOIST. CRANE OVERHEAD 19 07015							X		X				
15	GEARBOX MOTOR HOIST INTERMITTENT							14.1		X				
16	GEARBOX MOTOR HOIST MAIN							14.1		X				
17	BD/EKOM/19 02823 BLOCK DOUBLE SHEAVE WITH HOOK							X		X				
18	UPPER BLOCK							X		X				
19	BD/EKOM/19 02824 WIRE 18 MM MIN BRUDD 32,9 T							14.1		X				
20	WIRE END CONNECTION OUTER							14.1		X				
21	WIRE END CONNECTION							14.1		X				
22	BD/EKOM/43 ZE-29556 ELEMENT POSITION REFLECTOR "A" 19 07015						X							
23	BD/EKOM/43 ZE-29557 ELEMENT POSITION REFLECTOR "B" 19 07015						X							
24	BD/EKOM/43 ZS-29173 SWITCH LIMIT LASER 19 07015			6.1			X							
25	BD/EKOM/43 ZS-29174 SWITCH LIMIT LASER 19 0701			6.1			X							
26	BD/EKOM/43 TY-07012 ELEM TEMP CONVERSION FOR MOTOR 30 07017						X							
27	BD/EKOM/43 TY-07258 ELEM TEMPE CONVERSION FOR MOTOR 30 07259						X							
28	BD/EKOM/28 JB-08238 JUNCTION BOX						X							
29	BD/EKOM/28 JE-07010 BOX JUNCTION OVERHEAD CRANE 19 07015						X							
30	BD/EKOM/43 JB-03961 JB OVERRIDE SWITCH ANTI COLL. 19-07015			6.1			X							
31	BD/EKOM/43 JB-03971 JUNCTION BOX EX ANTI COLLISION 19-07015						X							
32	BD/EKOM/43 ZS-01854 SWITCH POS TRAVEL OVERH CRANE 19 07015			6.1			X							
33	BD/EKOM/43 ZS-01855 SWITCH POS TRAVEL OVERH CRANE 19 07015			6.1			X							
34	BD/EKOM/43 ZS-01850 SW LIMIT HOOK POS OVERH CRANE 19 07015									X	14.1	14.1		
35	BD/EKOM/43 ZS-01852 SWITCH POS TROLLY OVERH CRANE 19 07015			13.1					X					
36	BD/EKOM/43 ZS-01853 SWITCH POS TROLLY OVERH CRANE 19 07015			13.1					X					
37	OVERLOAD SWITCH HOIST									X				14.1
38	BD/EKOM/28 07010 SWITCH MAIN FOR OVERHEAD CRANE 19 07015						X		6.1	6.1				
39	BD/EKOM/28 07011 SWITCH PUSH BUTTON STATION FOR 19 07015						X		6.1	6.1				
40	BD/EKOM/28 08293 SWITCH EMERG STOP CRANE 19 07015						X		6.1	6.1				
41	BD/EKOM/28 LCP-07010 PANEL CONTROL. OVERHEAD CRANE 19 07015						X		6.1	6.1	6.1			
43	BRIDGE GEAR RACK						X							
44	RUNWAY BEAMS							X						
45	TROLLEY TRAVEL WHEELS							X	X					
46	BD/EKOM/30 07011 MOTOR TROLLEY. CRANE OVERHEAD 19 07015								X					
47	GEARBOX TROLLEY MOTOR								X					
48	PINION TROLLEY DRIVE								X					
49	DRUM BEARINGS									X				

FF#	COMP	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Local	System	Plant	LTA
2.1	2		BUMPER	2.1	Brittle	2.1.1	Age	Broken bumpers	Limited damping of bridge if collision	None imidiate	Yes
3.2	3		CABLE TRAY	3.1	Bent	3.1.1	Colliding into other structures, because of hooking	Cables could be broken	No connection with motors or instruments	Material handling not possible	Yes
4.1	4	BD/EKOM/27 23859	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	4.1.1	Age	No heating in motor	Bridge function could stop working if motor gets exees moisture	None imidiate	Yes
4.1	5	BD/EKOM/27 23860	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	4.1.1	Age	No heating in motor	Bridge function could stop working if motor gets exees moisture	None imidiate	Yes
6.1	6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.1	Motor bearing defective	6.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6.1	6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.2	Motor cage or rotor defective	6.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6.1	6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.3	Brake not releasing	6.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6.1	7	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.1	Motor bearing defective	7.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6.1	7	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.2	Motor cage or rotor defective	7.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6.1	7	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.3	Brake not releasing	7.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
6.1	8	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	8.1	Gearbox not rotating	8.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
6.1	9	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	9.1	Gearbox not rotating	9.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
6.1	10		DRIVE PINION	10.1	Drive pinion not rotating	10.1.1	Broken theets	No movent on rack drive	Bridge travel restricted	Material handling not possible	Yes
6.1	11		DRIVE CHAIN	11.1	Drive chain broken	11.1.1	Aberration	No movement on pinion	Bridge travel restricted	Material handling not possible	Yes
6.1	12		TRAVEL WHEELS	12.1	Deformed	12.1.1	Bearing failure	Limited movement	Bridge travel restricted	Material handling not possible	Yes
6.1	22	BD/EKOM/43 ZE-29558	ELEMENT POSITION REFLECTOR "A" 19 07015	22.1	Missing	22.1.1	Detached from location	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6.1	23	BD/EKOM/43 ZE-29559	ELEMENT POSITION REFLECTOR "B" 19 07015	23.1	Missing	23.1.1	Detached from location	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6.1	24	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	24.1	False indication	24.1.1	Dirty due to lack of cleaning	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6.1	24	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	24.1	False indication	24.1.2	Missing heating elements or lack of removal of moisture	Anti-collision activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6.1	25	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	25.1	False indication	25.1.1	Dirty due to lack of cleaning	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6.1	25	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	25.1	False indication	25.1.2	Missing heating elements or lack of removal of moisture	Anti-collision activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6.1	26	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.1	Shorted	26.1.1	Age	No movement in drive motor east	Bridge travel restricted	Material handling not possible	Yes
6.1	26	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.2	False indication	26.2.1	Age	No movement in drive motor east	Bridge travel restricted	Material handling not possible	Yes
6.1	27	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.1	Shorted	27.1.1	Age	No movement in drive motor west	Bridge travel restricted	Material handling not possible	Yes
6.1	27	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.2	False indication	27.2.1	Age	No movement in drive motor west	Bridge travel restricted	Material handling not possible	Yes
6.1	28		JUNCTION BOX	28.1	Shorted	28.1.1	Shorted because of moisture	No movement in drive motor west	Bridge travel restricted	Material handling not possible	Yes
6.1	29	BD/EKOM/28 JE-07015	BOX JUNCTION OVERHEAD CRANE 19 07015	29.1	Shorted	29.1.1	Shorted because of moisture	No movement in drive motor east	Bridge travel restricted	Material handling not possible	Yes
6.1	30	BD/EKOM/43 JB-03962	JB OVERRIDE SWITCH ANTI COLL. 19-07015	30.1	Shorted	30.1.1	Shorted because of moisture - Connection broken	Not possible to override anti-collission	Bridge travel restricted if anti-collission is activated	Material handling not possible if anti-collission is unintendedly activated	Yes

6.1	31	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07015	31.1	Shorted	31.1.1	Shorted because of moisture - Connection broken	Anti-collision activated	Bridge travel restricted one or both directions	Moving the crane in one or both directions is not possible	Yes
6.1	32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.1	False indication	32.1.1	Age	Limit switch activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6.1	32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.1	False indication	32.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6.1	32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.2	Broken	32.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted south direction	Moving the crane south is not possible	Yes
6.1	33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	33.1	False indication	33.1.1	Age	Limit switch activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6.1	33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	33.1	False indication	32.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6.1	33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.2	Broken	32.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted north direction	Moving the crane north is not possible	Yes
6.1	38	BD/EKOM/28 07015	SWITCH MAIN FOR OVERHEAD CRANE 19 07015	38.1	Shorted	38.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
6.1	39	BD/EKOM/28 07016	SWITCH PUSH BUTTON STATION FOR 19 07015	39.1	Shorted	39.1.1	Shorted because of moisture	Bridge control function not working	Bridge travel restricted	Material handling not possible	Yes
6.1	40	BD/EKOM/28 08294	SWITCH EMERG STOP CRANE 19 07015	40.1	Shorted	40.1.1	Shorted because of moisture	Not possible to start the crane	Not possible to start the crane	Material handling not possible	Yes
6.1	41	BD/EKOM/28 LCP-07015	PANEL CONTROL. OVERHEAD CRANE 19 07015	41.1	Shorted	41.1.1	Shorted because of moisture	Not possible to start the crane	Not possible to start the crane	Material handling not possible	Yes
6.1	43		BRIDGE GEAR RACK	43.1	Broken	43.1.1	Missing rack theets	No contact between pinion and rack	Bridge travel restricted	Material handling not possible	Yes
12.3	12		TRAVEL WHEELS	12.2	Structural failure	12.2.1	Massive degradation to structure	Overload of existing structure.	Bridge collapse	Crane collapse	Yes
12.3	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.4	Brake not engaging	14.4.1	Wear and tear	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
12.3	17	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.2	Severe structural corrosion	17.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
12.3	18		UPPER BLOCK	18.2	Severe structural corrosion	18.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
12.3	44		RUNWAY BEAMS	44.1	Severe structural corrosion	44.1.1	Lack of sufficient cross section in structural supports	Not holding load	Crane runway falling down	Crane collapse	Yes
12.3	45		TROLLEY TRAVEL WHEELS	45.1	Severe structural corrosion	45.1.1	Lack of sufficient cross section in axle	Not holding load	Trolley boogie falling down	Trolley collapse	Yes
13.1	13		TROLLEY GEAR RACK	13.1	Broken	13.1.1	Missing rack theets	No contact between pinion and rack	Trolley travel restricted	Material handling not possible	Yes
13.1	35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.1	False indication	35.1.1	Age	Not possible to move the trolley in west direction	Trolley travel restricted west	Material handling limited	Yes
13.1	35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.1	False indication	35.1.2	Dirt activating the switch	Not possible to move the trolley in west direction	Trolley travel restricted west	Material handling limited	Yes
13.1	35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.2	Broken	35.2.1	Moisture in the electronics	Not possible to move the trolley in west direction	Trolley travel restricted west	Material handling limited	Yes
13.1	36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.1	False indication	36.1.1	Age	Not possible to move the trolley in east direction	Trolley travel restricted east	Material handling limited	Yes
13.1	36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.1	False indication	36.1.2	Dirt activating the switch	Not possible to move the trolley in east direction	Trolley travel restricted east	Material handling limited	Yes
13.1	36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.2	Broken	36.2.1	Moisture in the electronics	Not possible to move the trolley in east direction	Trolley travel restricted east	Material handling limited	Yes
13.1	45		TROLLEY TRAVEL WHEELS	45.1	Deformed	45.1.1	Bearing failure	Limited movement	Trolley travel restricted	Material handling not possible	Yes
13.1	46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.1	Motor bearing defective	13.1.1	Insufficient lubrication	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
13.1	46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.2	Motor cage or rotor defective	13.2.1	Age	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
13.1	46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.3	Brake not releasing	13.3.1	Worn brake	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
13.1	47		GEARBOX TROLLEY MOTOR	47.1	Gearbox not rotating	47.1.1	Broken gears	No movement in output axle	Trolley travel restricted	Material handling not possible	Yes
13.1	48		PINION TROLLEY DRIVE	48.1	Drive pinion not rotating	48.1.1	Broken theets	No movent on rack drive	Trolley travel restricted	Material handling not possible	Yes

14.1	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.1	Motor bearing defective	14.1.1	Insufficient lubrication	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
14.1	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.2	Motor cage or rotor defective	14.2.1	Age	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
14.1	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.3	Brake not releasing	14.3.1	Worn brake	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
14.1	15		GEARBOX MOTOR HOIST INTERMITTENT	15.1	Gearbox not rotating	15.1.1	Broken gears	No movement in output axle	Hoist movement restricted	Material handling not possible	Yes
14.1	16		GEARBOX MOTOR HOIST MAIN	16.1	Gearbox not rotating	16.1.1	Broken gears	No movement in output axle	Hoist movement restricted	Material handling not possible	Yes
14.1	17	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.1	Corrosion in bearings	17.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
14.1	18		UPPER BLOCK	18.1	Corrosion in bearings	18.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
14.1	19	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.1	Broken	19.1.1	Broken because of severe missuse or deterioation	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
14.1	19	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.3	Corroded	19.3.1	Lack of lubrication	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
14.1	20		WIRE END CONNECTION OUTER	20.1	Broken	20.1.1	Broken because of severe missuse or deterioation	No end connection able to hold the load.	Hook movement restricted	Material handling not possible	Yes
14.1	21		WIRE END CONNECTION	21.1	Broken	21.1.1	Broken because of severe missuse or deterioation	No end connection able to hold the load if wire is spooled all out of the drum	None imidiate	None imidiate	Yes
14.1	34	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.1	False indication	34.1.1	Age	Limit switch activated	Could give restictions for how low the hook can be lovered and how high a load can be lifted	None imidiate	Yes
14.1	34	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.2	Incorrect setting	34.2.1	Unkown	Limit switch activated	Could give restictions for how low the hook can be lovered and how high a load can be lifted	None imidiate	Yes
14.1	37		OVERLOAD SWITCH HOIST	37.1	False indication	37.1.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
14.1	37		OVERLOAD SWITCH HOIST	37.2	Incorrect setting	37.1.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
14.1	49		DRUM BEARINGS	49.1	Bearing failure	49.1.1	Insufficient lubrication	Bearing failure	Hoist movement restricted	Material handling not possible	Yes

FF#	COMP	TAG	Component Description	FM#	Failure Mode	Evident?	Safety?	Outage?	Cat	Comment
2.1	2		BUMPER	2.1	Brittle	No	No	No	D/C	
3.2	3		CABLE TRAY	3.1	Bent	Yes	No	Yes	B	Could stop the whole crane
4.1	4	BD/EKOM/27 23859	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	No	No	Yes	D/C	
4.1	5	BD/EKOM/27 23860	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	No	No	Yes	D/C	
6.1	6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.1	Motor bearing defective	Yes	No	Yes	B	
6.1	6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.2	Motor cage or rotor defective	Yes	No	Yes	B	
6.1	6	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.3	Brake not releasing	Yes	No	Yes	B	
6.1	7	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.1	Motor bearing defective	Yes	No	Yes	B	
6.1	7	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.2	Motor cage or rotor defective	Yes	No	Yes	B	
6.1	7	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.3	Brake not releasing	Yes	No	Yes	B	
6.1	8	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	8.1	Gearbox not rotating	Yes	No	Yes	B	
6.1	9	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	9.1	Gearbox not rotating	Yes	No	Yes	B	
6.1	10		DRIVE PINION	10.1	Drive pinion not rotating	Yes	No	Yes	B	
6.1	11		DRIVE CHAIN	11.1	Drive chain broken	Yes	No	Yes	B	
6.1	12		TRAVEL WHEELS	12.1	Deformed	Yes	No	Yes	B	
6.1	22	BD/EKOM/43 ZE-29558	ELEMENT POSITION REFLECTOR "A" 19 07015	22.1	Missing	Yes	No	Yes	B	
6.1	23	BD/EKOM/43 ZE-29559	ELEMENT POSITION REFLECTOR "B" 19 07015	23.1	Missing	Yes	No	Yes	B	
6.1	24	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	24.1	False indication	Yes	Yes		A	
6.1	24	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	24.1	False indication	Yes	Yes		A	
6.1	25	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	25.1	False indication	Yes	Yes		A	
6.1	25	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	25.1	False indication	Yes	Yes		A	
6.1	26	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.1	Shorted	Yes	No	Yes	B	
6.1	26	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.2	False indication	Yes	No	Yes	B	
6.1	27	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.1	Shorted	Yes	No	Yes	B	
6.1	27	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.2	False indication	Yes	No	Yes	B	
6.1	28		JUNCTION BOX	28.1	Shorted	Yes	No	Yes	B	
6.1	29	BD/EKOM/28 JE-07015	BOX JUNCTION OVERHEAD CRANE 19 07015	29.1	Shorted	Yes	No	Yes	B	
6.1	30	BD/EKOM/43 JB-03962	JB OVERRIDE SWITCH ANTI COLL. 19-07015	30.1	Shorted	Yes	Yes		A	
6.1	31	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07015	31.1	Shorted	Yes	Yes		A	
6.1	32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.1	False indication	Yes	Yes		A	
6.1	32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.1	False indication	Yes	Yes		A	
6.1	32	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.2	Broken	Yes	Yes		A	
6.1	33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	33.1	False indication	Yes	Yes		A	

6.1	33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	33.1	False indication	Yes	No	Yes	B	
6.1	33	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.2	Broken	Yes	Yes		A	
6.1	38	BD/EKOM/28 07015	SWITCH MAIN FOR OVERHEAD CRANE 19 07015	38.1	Shorted	Yes	Yes		A	
6.1	39	BD/EKOM/28 07016	SWITCH PUSH BUTTON STATION FOR 19 07015	39.1	Shorted	Yes	Yes		A	
6.1	40	BD/EKOM/28 08294	SWITCH EMERG STOP CRANE 19 07015	40.1	Shorted	Yes	No	Yes	B	
6.1	41	BD/EKOM/28 LCP-07015	PANEL CONTROL. OVERHEAD CRANE 19 07015	41.1	Shorted	Yes	Yes		A	
6.1	43		BRIDGE GEAR RACK	43.1	Broken	Yes	Yes		A	
12.3	12		TRAVEL WHEELS	12.2	Structural failure	Yes	Yes		A	
12.3	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.4	Brake not engaging	Yes	Yes		A	
12.3	17	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.2	Severe structural corrosion	Yes	Yes		A	
12.3	18		UPPER BLOCK	18.2	Severe structural corrosion	Yes	Yes		A	
12.3	44		RUNWAY BEAMS	44.1	Severe structural corrosion	Yes	No	Yes	B	
12.3	45		TROLLEY TRAVEL WHEELS	45.1	Severe structural corrosion	Yes	Yes		A	
13.1	13		TROLLEY GEAR RACK	13.1	Broken	Yes	Yes		A	
13.1	35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.1	False indication	Yes	Yes		A	
13.1	35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.1	False indication	Yes	Yes		A	
13.1	35	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.2	Broken	Yes	No	Yes	B	
13.1	36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.1	False indication	Yes	No	Yes	B	
13.1	36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.1	False indication	Yes	No	Yes	B	
13.1	36	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.2	Broken	Yes	No	Yes	B	
13.1	45		TROLLEY TRAVEL WHEELS	45.1	Deformed	Yes	No	Yes	B	
13.1	46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.1	Motor bearing defective	Yes	No	Yes	B	
13.1	46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.2	Motor cage or rotor defective	Yes	No	Yes	B	
13.1	46	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.3	Brake not releasing	Yes	No	Yes	B	
13.1	47		GEARBOX TROLLEY MOTOR	47.1	Gearbox not rotating	Yes	No	Yes	B	
13.1	48		PINION TROLLEY DRIVE	48.1	Drive pinion not rotating	Yes	Yes		A	
14.1	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.1	Motor bearing defective	Yes	Yes		A	
14.1	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.2	Motor cage or rotor defective	Yes	No	Yes	B	
14.1	14	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.3	Brake not releasing	Yes	No	Yes	B	
14.1	15		GEARBOX MOTOR HOIST INTERMITTENT	15.1	Gearbox not rotating	Yes	Yes		A	

14.1	16		GEARBOX MOTOR HOIST MAIN	16.1	Gearbox not rotating	Yes	Yes		A	
14.1	17	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.1	Corrosion in bearings	Yes	Yes		A	
14.1	18		UPPER BLOCK	18.1	Corrosion in bearings	Yes	Yes		A	
14.1	19	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.1	Broken	Yes	Yes		A	
14.1	19	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.3	Corroded	Yes	Yes		A	
14.1	20		WIRE END CONNECTION OUTER	20.1	Broken	Yes	Yes		A	
14.1	21		WIRE END CONNECTION	21.1	Broken	Yes	Yes		A	
14.1	34	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.1	False indication	Yes	Yes		A	
14.1	34	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.2	Incorrect setting	Yes	Yes		A	
14.1	37		OVERLOAD SWITCH HOIST	37.1	False indication	Yes	Yes		A	
14.1	37		OVERLOAD SWITCH HOIST	37.2	Incorrect setting	Yes	Yes		A	
14.1	49		DRUM BEARINGS	49.1	Bearing failure	Yes	Yes		A	

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Cat	1	2	3	4	5	6	7	Candidate Tas	Effective Info	Selective dec.	Est Freq.
12.3	12	Bridge		TRAVEL WHEELS	12.2	Structural failure	12.2.1	Massive degradation to structure	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6.1	6	Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.1	Motor bearing defective	6.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
6.1	6	Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.2	Motor cage or rotor defective	6.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
6.1	6	Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.3	Brake not releasing	6.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6.1	7	Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.1	Motor bearing defective	7.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
6.1	7	Bridge	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.2	Motor cage or rotor defective	7.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
6.1	7	Bridge	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.3	Brake not releasing	7.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6.1	8	Bridge	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	8.1	Gearbox not rotating	8.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
6.1	9	Bridge	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	9.1	Gearbox not rotating	9.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
6.1	10	Bridge		DRIVE PINION	10.1	Drive pinion not rotating	10.1.1	Broken theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
6.1	11	Bridge		DRIVE CHAIN	11.1	Drive chain broken	11.1.1	Aberration	B	P	Y	N	N	-	Y	-	1. Inspect, clean and lubricate - TD 2. Change - TD		1. Inspect, clean and lubricate - TD	1Y
6.1	12	Bridge		TRAVEL WHEELS	12.1	Deformed	12.1.1	Bearing failure	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
13.1	13	Bridge		TROLLEY GEAR RACK	13.1	Broken	13.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
3.2	3	Bridge		CABLE TRAY	3.1	Bent	3.1.1	Colliding into other structures, because of hooking	B	P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation - TD	1Y
2.1	2	Bridge		BUMPER	2.1	Brittle	2.1.1	Age	D/C	N	-	N	Y	N	N	N	RTF		RTF	

4.1	4	Bridge	BD/EKOM/27 23859	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	4.1.1	Age	D/C	P	Y	N	Y	N	Y	-	1. Inspect for external damage. - TD 2. Open and check internally - TD	Information obtained in previous analysis of 07010	1. Inspect for external damage. - TD 2. Open and check internally - TD	1. 3M 2. 6M
4.1	5	Bridge	BD/EKOM/27 23860	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	5.1.1	Age	D/C	P	Y	N	Y	N	Y	-	1. Inspect for external damage. - TD 2. Open and check internally - TD	Information obtained in previous analysis of 07010	1. Inspect for external damage. - TD 2. Open and check internally - TD	1. 3M 2. 6M
14.1	15	Hoist		GEARBOX MOTOR HOIST INTERMITTENT	15.1	Gearbox not rotating	15.1.1	Broken gears	A	P	Y	N	N	-	Y	-	1. Verify oil level - TD 2. Change oil - TD	Crane OEM 4Y oil change. Gear OEM 1Y oil cahngce.	2. Change oil - TD	1Y
14.1	16	Hoist		GEARBOX MOTOR HOIST MAIN	16.1	Gearbox not rotating	16.1.1	Broken gears	A	P	Y	N	N	-	Y	-	1. Verify oil level - TD 2. Change oil - TD	Verifying oil level at certain interval and change oil at another interval. Changing the oil and inspection the oil gearbox every 4Y or 1460 days gives a reliability of 90,71%. MTBF = 1811 days	1. Verify oil level - TD 2. Change oil - TD	1. 1Y 2. 4Y
14.1	19	Hoist	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.1	Broken	19.1.1	Broken because of severe missuse or deterioation	A	Y	Y	N	N	-	Y	-	1. Inspect wire rope 2. Change wire rope	With reliability rate of 81,10% the wire rope should be changed every 180 days. MTBF = 599 days	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 6M
14.1	19	Hoist	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.3	Corroded	19.3.1	Lack of lubrication	A	P	Y	N	N	-	Y	-	1. Inspect wire rope 2. Lubricate wire rope		1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M
14.1	20	Hoist		WIRE END CONNECTION OUTER	20.1	Broken	20.1.1	Broken because of severe missuse or deterioation	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14.1	21	Hoist		WIRE END CONNECTION	21.1	Broken	21.1.1	Broken because of severe missuse or deterioation	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14.1	49	Hoist		DRUM BEARINGS	49.1	Bearing failure	49.1.1	Insufficient lubrication	A								1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	1Y

12.3	14	Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.4	Brake not engaging	14.4.1	Wear and tear	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12.3	17	Hoist	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.2	Severe structural corrosion	17.2.1	Lack of sufficient cross section in axle	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
12.3	18	Hoist		UPPER BLOCK	18.2	Severe structural corrosion	18.2.1	Lack of sufficient cross section in axle	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14.1	14	Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.1	Motor bearing defective	14.1.1	Insufficient lubrication	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
14.1	14	Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.2	Motor cage or rotor defective	14.2.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
14.1	14	Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.3	Brake not releasing	14.3.1	Worn brake	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
14.1	17	Hoist	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.1	Corrosion in bearings	17.1.1	Water penetration in bearings.	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M
14.1	18	Hoist		UPPER BLOCK	18.1	Corrosion in bearings	18.1.1	Water penetration in bearings.	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M
6.1	24	Instrument	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	24.1	False indication	24.1.1	Dirty due to lack of cleaning	A		P	Y	N	N	-	N	Y	1. Inspect and clean - TD 2. Assess possibility of heat tracing	With reliability rate of 80,24% the laser should be cleaned and inspected every 46 days. MTBF = 456 days	1. Inspect and clean - TD	3M
6.1	25	Instrument	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	25.1	False indication	25.1.1	Dirty due to lack of cleaning	A		P	Y	N	N	-	N	Y	1. Inspect and clean - TD 2. Assess possibility of heat tracing	With reliability rate of 80,24% the laser should be cleaned and inspected every 46 days. MTBF = 456 days	1. Inspect and clean - TD	3M

6.1	30	Instrument	BD/EKOM/43 JB-03962	JB OVERRIDE SWITCH ANTI COLL. 19-07015	30.1	Shorted	30.1.1	Shorted because of moisture - Connection broken	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Effectively OEM is referring to IEC 60079-17, which in terms are giving instructions to inspect at least every 3Y. 1Y is based on analysts personal experience of the build-up of moisture in JB offshore.	1. Inspect and clean - TD	1Y
6.1	31	Instrument	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07015	31.1	Shorted	31.1.1	Shorted because of moisture - Connection broken	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	32	Instrument	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.1	False indication	32.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	33	Instrument	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	33.1	False indication	33.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	39	Instrument	BD/EKOM/28 07016	SWITCH PUSH BUTTON STATION FOR 19 07015	39.1	Shorted	39.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	40	Instrument	BD/EKOM/28 08294	SWITCH EMERG STOP CRANE 19 07015	40.1	Shorted	40.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	41	Instrument	BD/EKOM/28 LCP-07015	PANEL CONTROL. OVERHEAD CRANE 19 07015	41.1	Shorted	41.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
13.1	35	Instrument	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.1	False indication	35.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
13.1	35	Instrument	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.2	Broken	35.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
13.1	36	Instrument	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.1	False indication	36.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
13.1	36	Instrument	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.2	Broken	36.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
14.1	34	Instrument	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.1	False indication	34.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y

14.1	34	Instrument	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.2	Incorrect setting	34.2.1	Unkown	A		P	Y	N	N	-	Y	-	1. Verify limits	Verify the limits by running crane up and down. Adjust if necessary. Reliability of 80,14% achieved when using the interval of 165 days. MTBF = 1055 days. 90 days give a reliability of 86,87%.	1. Verify limits	3M
14.1	37	Instrument		OVERLOAD SWITCH HOIST	37.1	False indication	37.1.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
14.1	37	Instrument		OVERLOAD SWITCH HOIST	37.2	Incorrect setting	37.1.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Verify limits - TD	Using intervals gained from 07010	1. Verify limits - TD	9M
6.1	22	Instrument	BD/EKOM/43 ZE-29558	ELEMENT POSITION REFLECTOR "A" 19 07015	22.1	Missing	22.1.1	Detached from location	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Done prior to well intervention campaign	1. Inspect and clean - TD	3M
6.1	23	Instrument	BD/EKOM/43 ZE-29559	ELEMENT POSITION REFLECTOR "B" 19 07015	23.1	Missing	23.1.1	Detached from location	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Done prior to well intervention campaign	1. Inspect and clean - TD	3M
6.1	26	Instrument	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.1	Shorted	26.1.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	26	Instrument	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.2	False indication	26.2.1	Age	B										See FM 26.1		
6.1	27	Instrument	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.1	Shorted	27.1.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	27	Instrument	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.2	False indication	27.2.1	Age	B										See FM 27.1		
6.1	28	Instrument		JUNCTION BOX	28.1	Shorted	28.1.1	Shorted because of moisture	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	29	Instrument	BD/EKOM/28 JE-07015	BOX JUNCTION OVERHEAD CRANE 19 07015	29.1	Shorted	29.1.1	Shorted because of moisture	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
6.1	38	Instrument	BD/EKOM/28 07015	SWITCH MAIN FOR OVERHEAD CRANE 19 07015	38.1	Shorted	38.1.1	Shorted because of moisture	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 30.1	1. Inspect and clean - TD	1Y
12.3	44	Runway		RUNWAY BEAMS	44.1	Severe structural corrosion	44.1.1	Lack of sufficient cross section in structureal supports	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
6.1	43	Runway		BRIDGE GEAR RACK	43.1	Broken	43.1.1	Missing rack theets	B		P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
12.3	45	Trolley		TROLLEY TRAVEL WHEELS	45.1	Severe structural corrosion	45.1.1	Lack of sufficient cross section in axle	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y

13.1	45	Trolley		TROLLEY TRAVEL WHEELS	45.1	Deformed	45.1.1	Bearing failure	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
13.1	46	Trolley	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.1	Motor bearing defective	13.1.1	Insufficient lubrication	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
13.1	46	Trolley	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.2	Motor cage or rotor defective	13.2.1	Age	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
13.1	46	Trolley	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.3	Brake not releasing	13.3.1	Worn brake	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
13.1	47	Trolley		GEARBOX TROLLEY MOTOR	47.1	Gearbox not rotating	47.1.1	Broken gears	B		P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
13.1	48	Trolley		PINION TROLLEY DRIVE	48.1	Drive pinion not rotating	48.1.1	Broken theets	B		P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	1 940	2	0,708333333	0,208755483	7,570443252
2	1 682	1	0,291666667	-1,064673327	7,427738841
3					
4					
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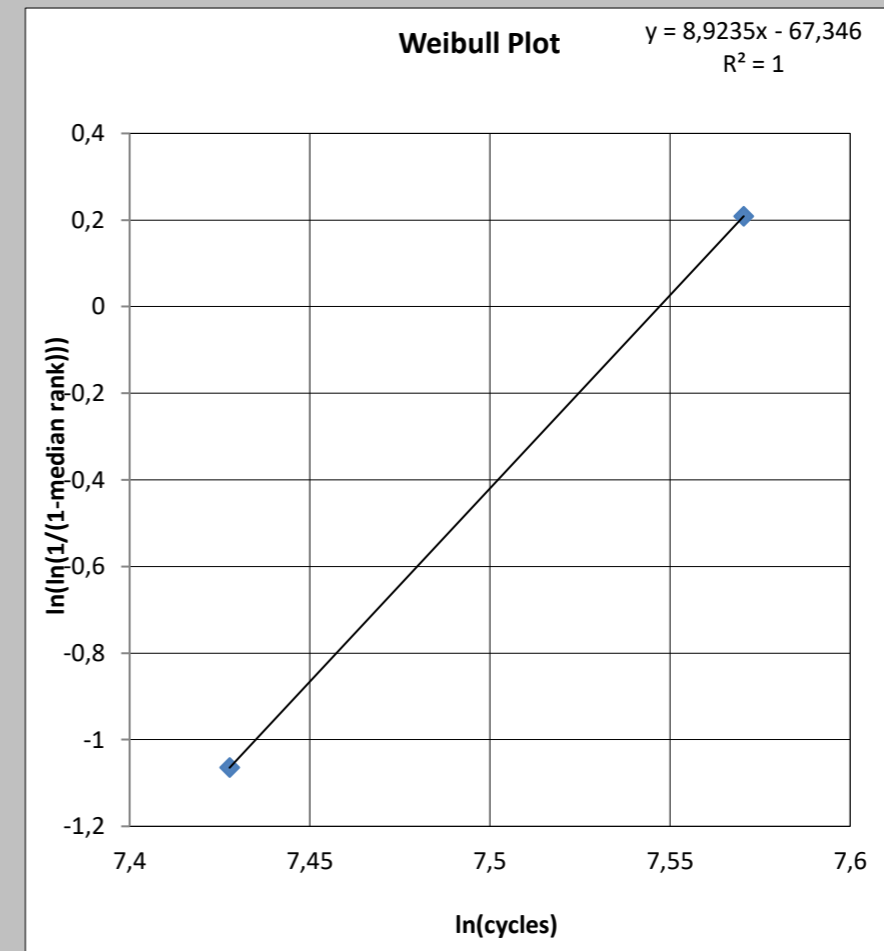
Enter the minimum number of cycles you desire the product to achieve: 1 460

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 8,92

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 1 895

Reliability at 1460 cycles 90,71 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 1460 cycles.

The Shape Parameter, Beta, is greater than 1 indicating that the product is experiencing normal wear out failure rate

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	855	4	0,685185185	0,144767396	6,751101469
2	286	2	0,314814815	-0,972686141	5,655991811
3	389	3	0,5	-0,366512921	5,963579344
4	1 316	5	0,87037037	0,714455486	7,182352112
5	147	1	0,12962963	-1,974458694	4,990432587
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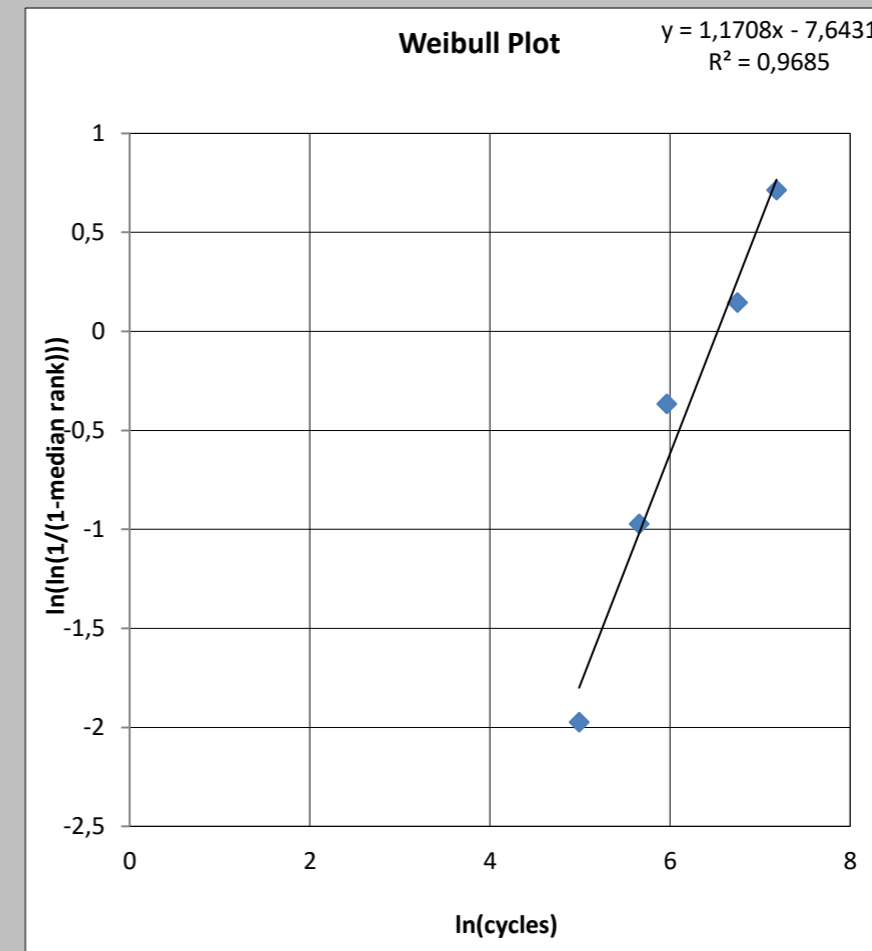
Enter the minimum number of cycles you desire the product to achieve: 180

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 1,17

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 684

Reliability at 180 cycles 81,10 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 180 cycles.

The Shape Parameter, Beta, is nearly equal to 1 indicating that the product is experiencing a constant failure rate

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	276	3	0,613636364	-0,050266149	5,620400866
2	212	2	0,386363636	-0,716717249	5,356586275
3	33	1	0,159090909	-1,752894273	3,496507561
4	1 302	4	0,840909091	0,608830072	7,171656823
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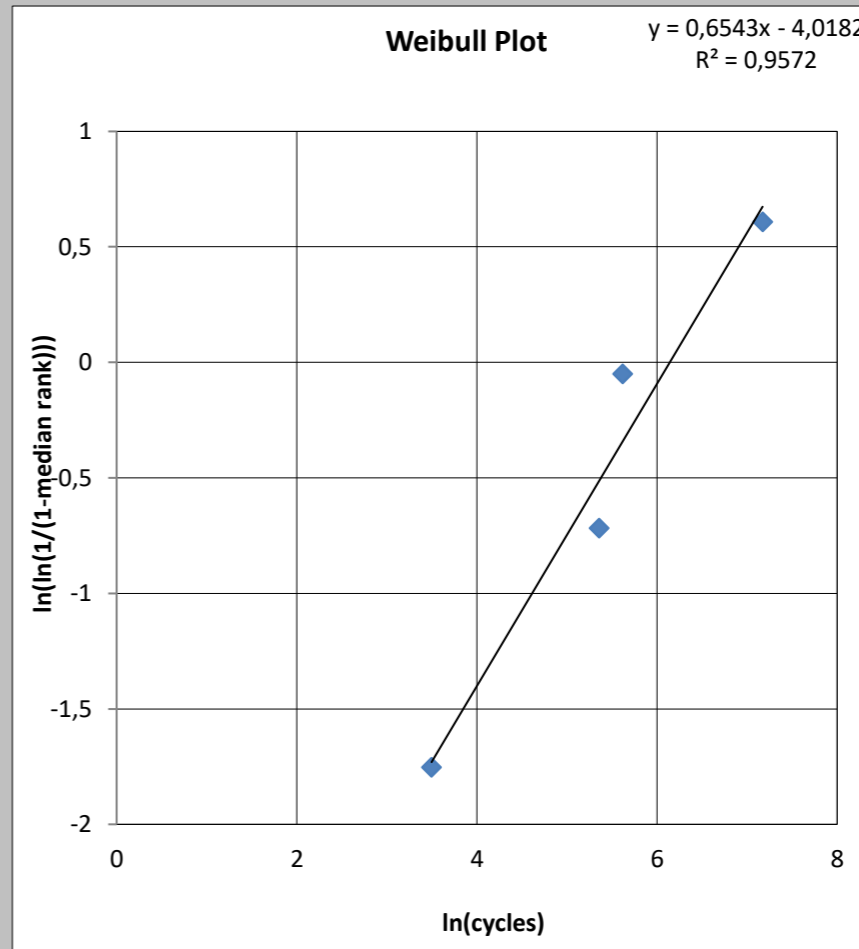
Enter the minimum number of cycles you desire the product to achieve: 46

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 0,65

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 465

Reliability at 46 cycles 80,24 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 46 cycles.

The Shape Parameter, Beta, is less than 1 indicating that the product is experiencing infant life failure rate

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	2 177	3	0,794117647	0,457709854	7,685703061
2	169	1	0,205882353	-1,467401781	5,129898715
3	820	2	0,5	-0,366512921	6,70930434
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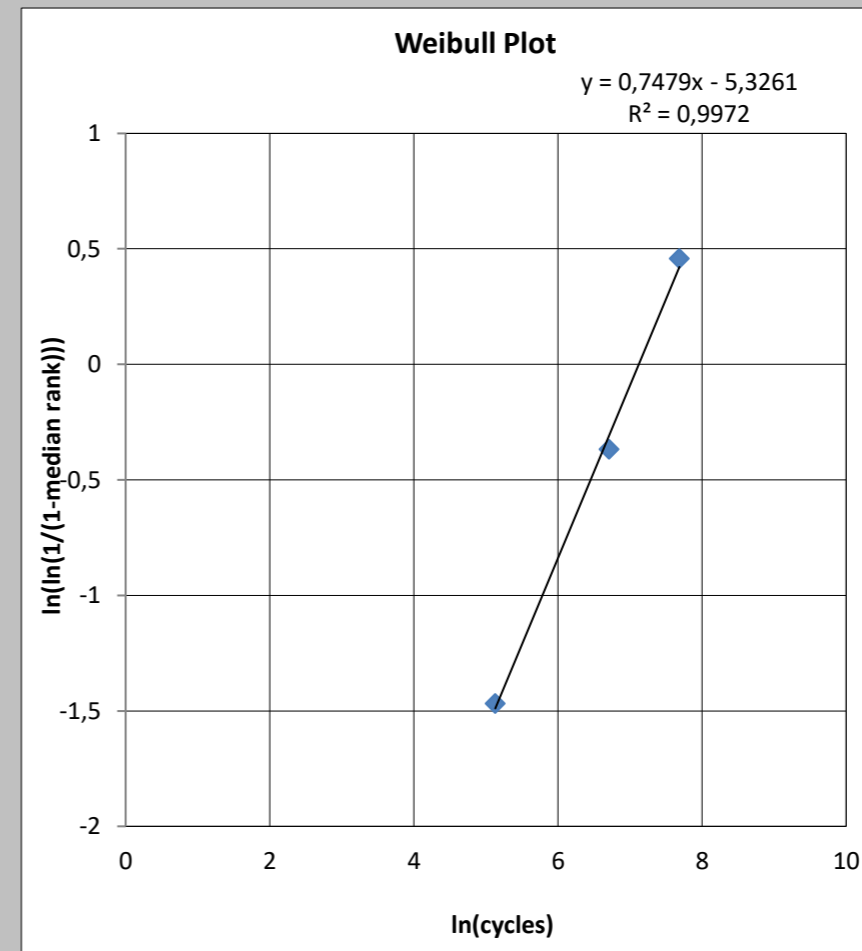
Enter the minimum number of cycles you desire the product to achieve: 165

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 0,75

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 1 239

Reliability at 165 cycles 80,14 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 165 cycles.

The Shape Parameter, Beta, is less than 1 indicating that the product is experiencing infant life failure rate

7-2 Sanity checklist

FF#	Comp #	TAG	Component Description	FM#	Failure mode	1	2	3	4	5	6	7	8	RTF	Selection Dec	Est Freq	Comments
2.1	2		BUMPER	2.1	Brittle	N	N	N	N	N	N	N	N	RTF	RTF		

7-3 Task comparison

System	TAG	Component Description	FM#	Failure Mode	RCM Selective dec.	Est Freq.
Bridge		BUMPER	2.1	Brittle	RTF	
Bridge		CABLE TRAY	3.1	Bent	1. Check for wear and tear or deformation - TD	1Y
Bridge	BD/EKOM/27 23859	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	1. Inspect for external damage. - TD 2. Open and check internally - TD	1. 3M 2. 6M
Bridge	BD/EKOM/27 23860	HEATER ELEMENT MOTOR 30 07017	4.1	Shorted	1. Inspect for external damage. - TD 2. Open and check internally - TD	1. 3M 2. 6M
Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y
Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y
Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	6.3	Brake not releasing	1. Inspect and clean - TD	1Y
Bridge	BD/EKOM/30 07017	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y
Bridge	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y
Bridge	BD/EKOM/30 07259	MOTOR TRAVEL E. CRANE OVERHEAD. 19 07015	7.3	Brake not releasing	1. Inspect and clean - TD	1Y
Bridge	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	8.1	Gearbox not rotating	1. Change oil - TD	4Y
Bridge	BD/EKOM/63 07057	GEARBOX. MOTOR TRAVELLING 30 07259	9.1	Gearbox not rotating	1. Change oil - TD	4Y
Bridge		DRIVE PINION	10.1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y
Bridge		DRIVE CHAIN	11.1	Drive chain broken	1. Inspect, clean and lubricate - TD	1Y
Bridge		TRAVEL WHEELS	12.2	Structural failure	1. Inspect and clean - TD	1Y
Bridge		TRAVEL WHEELS	12.1	Deformed	1. Inspect and clean - TD	1Y
Bridge		TROLLEY GEAR RACK	13.1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y
Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.4	Brake not engaging	1. Inspect and clean - TD	1Y
Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y
Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y
Hoist	BD/EKOM/30 07015	MOTOR HOIST. CRANE OVERHEAD 19 07015	14.3	Brake not releasing	1. Inspect and clean - TD	1Y
Hoist		GEARBOX MOTOR HOIST INTERMITTENT	15.1	Gearbox not rotating	2. Change oil - TD	1Y
Hoist		GEARBOX MOTOR HOIST MAIN	16.1	Gearbox not rotating	1. Verify oil level - TD 2. Change oil - TD	1. 1Y 2. 4Y
Hoist	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.2	Severe structural corrosion	1. Inspect and clean - TD	1Y
Hoist	BD/EKOM/19 02821	BLOCK DOUBLE SHEAVE WITH HOOK	17.1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M
Hoist		UPPER BLOCK	18.2	Severe structural corrosion	1. Inspect and clean - TD	1Y
Hoist		UPPER BLOCK	18.1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M

Hoist	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.1	Broken	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 6M
Hoist	BD/EKOM/19 02822	WIRE 18 MM MIN BRUDD 32,9 T	19.3	Corroded	1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M
Hoist		WIRE END CONNECTION OUTER	20.1	Broken	1. Inspect and clean - TD	1Y
Hoist		WIRE END CONNECTION	21.1	Broken	1. Inspect and clean - TD	1Y
Hoist		DRUM BEARINGS	49.1	Bearing failure	1. Lubricate with grease gun. - TD	1Y
Instrument	BD/EKOM/43 ZE-29558	ELEMENT POSITION REFLECTOR "A" 19 07015	22.1	Missing	1. Inspect and clean - TD	3M
Instrument	BD/EKOM/43 ZE-29559	ELEMENT POSITION REFLECTOR "B" 19 07015	23.1	Missing	1. Inspect and clean - TD	3M
Instrument	BD/EKOM/43 ZS-29171	SWITCH LIMIT LASER 19 07015	24.1	False indication	1. Inspect and clean - TD	3M
Instrument	BD/EKOM/43 ZS-29172	SWITCH LIMIT LASER 19 07015	25.1	False indication	1. Inspect and clean - TD	3M
Instrument	BD/EKOM/43 TY-07017	ELEM TEMP CONVERSION FOR MOTOR 30 07017	26.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 TY-07259	ELEM TEMPE CONVERSION FOR MOTOR 30 07259	27.1	Shorted	1. Inspect and clean - TD	1Y
Instrument		JUNCTION BOX	28.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/28 JE-07015	BOX JUNCTION OVERHEAD CRANE 19 07015	29.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 JB-03962	JB OVERRIDE SWITCH ANTI COLL. 19-07015	30.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 JB-03971	JUNCTION BOX EX ANTI COLLISION 19-07015	31.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 ZS-01860	SWITCH POS TRAVEL OVERH CRANE 19 07015	32.1	False indication	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 ZS-01861	SWITCH POS TRAVEL OVERH CRANE 19 07015	33.1	False indication	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.1	False indication	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 ZS-01856	SW LIMIT HOOK POS OVERH CRANE 19 07015	34.2	Incorrect setting	1. Verify limits	3M
Instrument	BD/EKOM/43 ZS-01858	SWITCH POS TROLLY OVERH CRANE 19 07015	35.1	False indication	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/43 ZS-01859	SWITCH POS TROLLY OVERH CRANE 19 07015	36.1	False indication	1. Inspect and clean - TD	1Y
Instrument		OVERLOAD SWITCH HOIST	37.1	False indication	1. Inspect and clean - TD	1Y
Instrument		OVERLOAD SWITCH HOIST	37.2	Incorrect setting	1. Verify limits - TD	9M
Instrument	BD/EKOM/28 07015	SWITCH MAIN FOR OVERHEAD CRANE 19 07015	38.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/28 07016	SWITCH PUSH BUTTON STATION FOR 19 07015	39.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/28 08294	SWITCH EMERG STOP CRANE 19 07015	40.1	Shorted	1. Inspect and clean - TD	1Y
Instrument	BD/EKOM/28 LCP-07015	PANEL CONTROL. OVERHEAD CRANE 19 07015	41.1	Shorted	1. Inspect and clean - TD	1Y
Runway		BRIDGE GEAR RACK	43.1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y
Runway		RUNWAY BEAMS	44.1	Severe structural corrosion	1. Inspect and clean - TD	1Y
Trolley		TROLLEY TRAVEL WHEELS	45.1	Severe structural corrosion	1. Inspect and clean - TD	1Y
Trolley		TROLLEY TRAVEL WHEELS	45.1	Deformed	1. Inspect and clean - TD	1Y
Trolley	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y
Trolley	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y
Trolley	BD/EKOM/30 07016	MOTOR TROLLEY. CRANE OVERHEAD 19 07015	46.3	Brake not releasing	1. Inspect and clean - TD	1Y

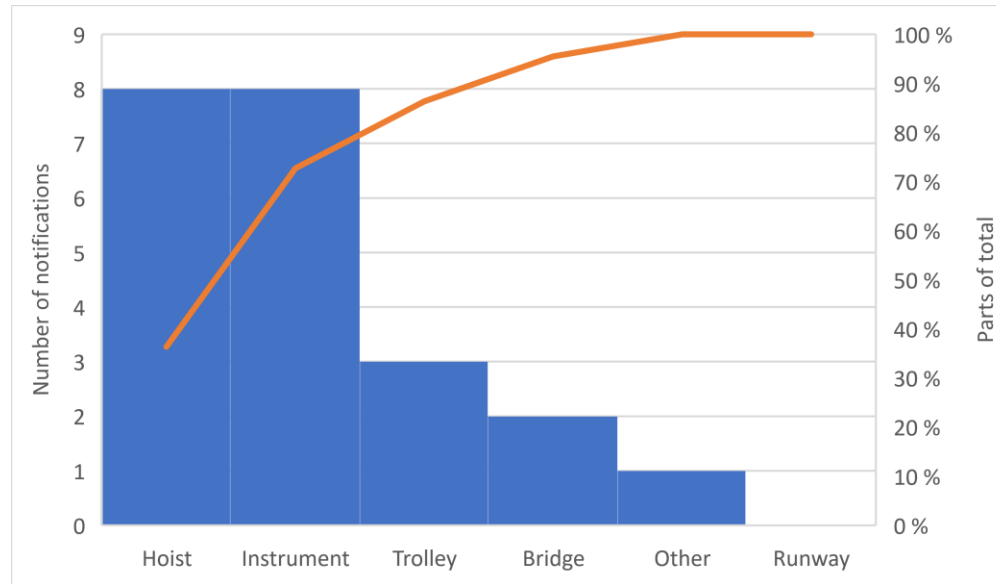
Trolley		GEARBOX TROLLEY MOTOR	47.1	Gearbox not rotating	1. Change oil - TD	4Y
Trolley		PINION TROLLEY DRIVE	48.1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y

Complete Analysis
TAG NO. 07020

1-1 Notifications and history

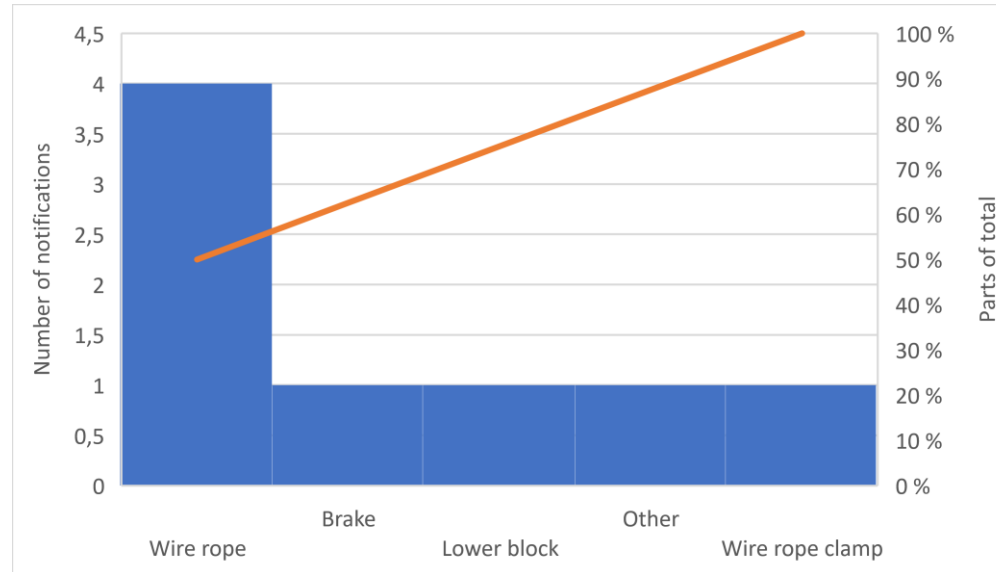
Overall

Bridge	2	0,09090909
Hoist	8	0,36363636
Instrument	8	0,36363636
Other	1	0,04545455
Runway	0	0
Trolley	3	0,13636364
Totalt minus kansellert	22	
Kansellert	4	
Totalt	26	
Opptelling fra Notifikasjoner	26	



Hoist

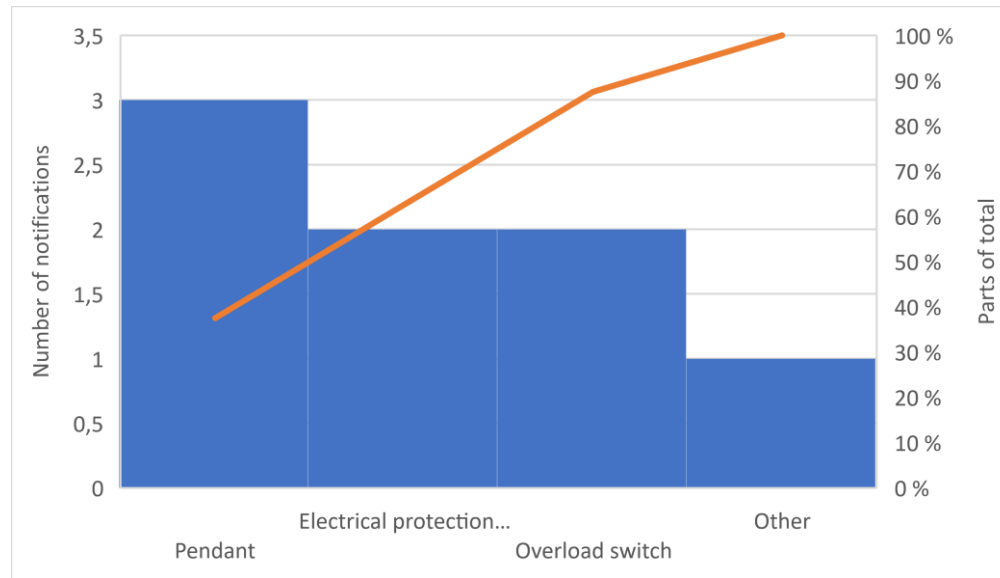
Brake	1	0,125
Lower block	1	0,125
Other	1	0,125
Wire rope	4	0,5
Wire rope clamp	1	0,125



Instrument

Electrical protection devices
Overload switch
Pendant
Other

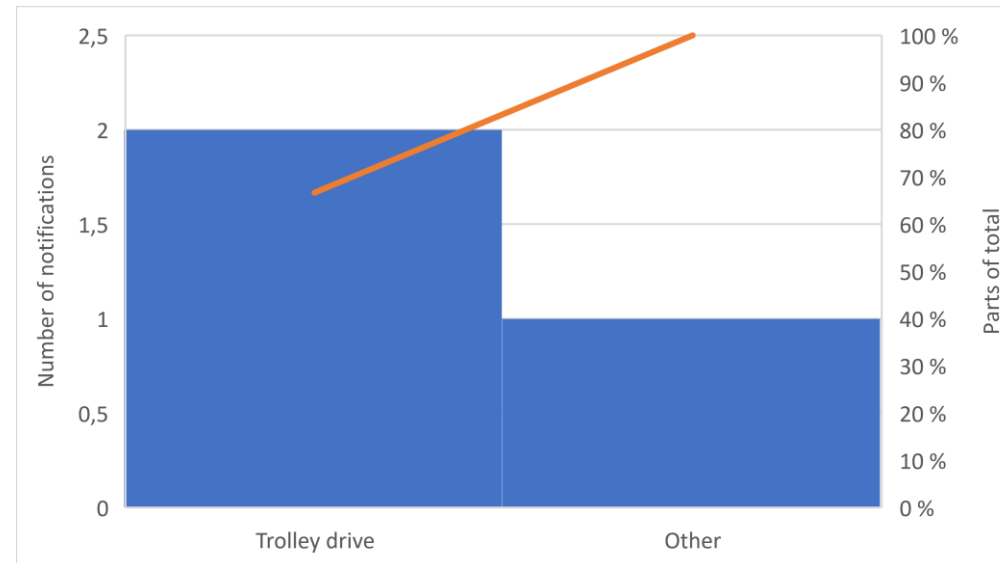
8
2 0,25
2 0,25
3 0,375
1 0,125



Trolley

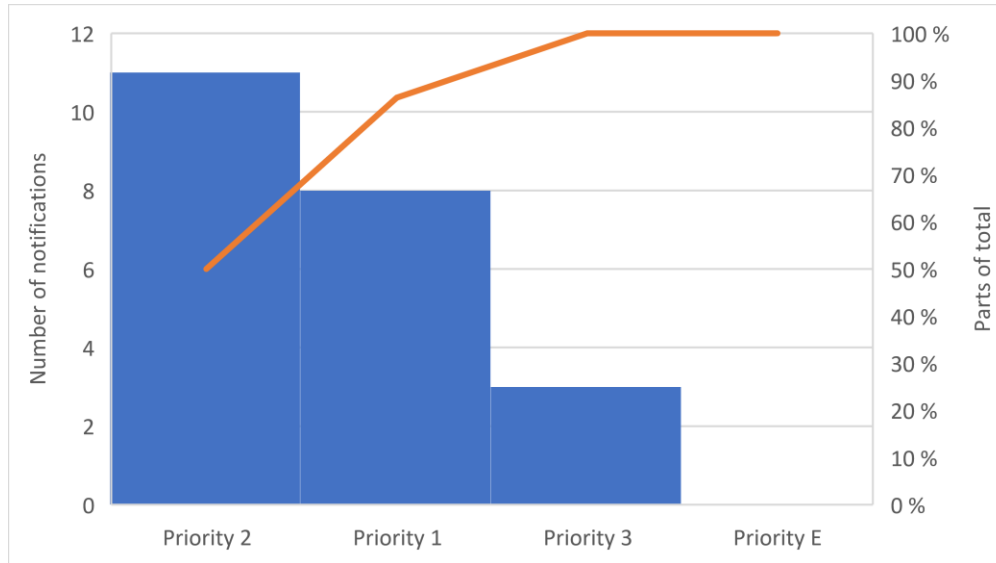
Trolley drive
Other

3
2 0,66666667
1 0,33333333



Priority

Priority E	0	0
Priority 1	8	0,36363636
Priority 2	11	0,5
Priority 3	3	0,13636364



RCM – Systems analysis

Step 2-1:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Overview	System ID:	BD/EKOM/840/19 07020
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07020	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Major Equipment Included:

Bridge:

- Girder main assembly – C654-101
- Gearbox traveling motors N/S – ET3010/MR1
- Traveling motors N/S – DB35 90S4 0,87kW
- Travelling wheels
- Cable loop arrangement – S1-E 312391
- Drive pinions

Hoist:

- Motor hoist – PB35 200LB412 13/4,4kW
- Hoist Gearbox – ET3065/MR1
- Wire rope Ø14mm x 50m
- Lower block – P59-99
- Upper block – P59-138

Instrument:

- Radio remote – HBC FST 735-09-1315-C
- Limit switches – 1S5, 1S6, 2S5, 2S6, 3S5, 3S6 – NCN20+U1+NO Pepperl & Fuchs
- Overload switch – 3S9 – ZS 336 – 11Z Schmersal

Runway:

- Runway beams
- Runway bridge travel racks

Trolley:

- Motor travel – DB35 90S4 0,87kW
- Gearbox – A412 UR F1A
- Travelling pinions – L43-4-023 U047
- Travelling Wheels – B30-121

Primary Physical Boundaries

Start with:

Main electrical supply 3x690V 60Hz – FROM: 28-00002-05C

Supports for runway beams

Terminate with:

Lifted load. Attached in crane hook.

Caveats:

N/A

RCM – Systems analysis

Step 2-2:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Details	System ID:	BD/EKOM/840/19 07020
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07020	Date:	08.04.2018
Subsystem:			
Analyst	Øystein Refsland Andreassen		

Type	Bounding System	Interface Location	Ref. Drawing
IN (Electrical)	Instrument	28-00002-05C	E900-11915-E-00077
IN (Structural support)	Runway	W30	E900-11915-M-0038
OUT (Load)	Hoist	W30	E900-11915-M-0038

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07020
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07020	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Functional Description/Key Parameters

The Electrical Overhead Travelling Cranes are of underslung monobox special design for Ekofisk platform, 2/4M module W30.

Main Girder is made as box of plates and the end trucks are made of channel profiles and steel plates.

Cranes are made for Zone 1 hazardous area. All el. equipment designed for Zone 1.

The cranes are for offshore installations with ambient temperature -20 deg C.

following main data:

Capacity: 15T

Span: 6000 mm

Height of lift: 10 m

Hoisting speed: 3,6/0,9 m/min (two speed)

Trolley speed: 6 m/min

Crane speed: 6 m/min

Power supply: 690V/60Hz/3ph

Heel: 1 deg.

Runway beams: HE260M

Further according to GA dwg. No.: E900-11915-M-00007-001

Crane bridge:

The crane bridge is running on runway beams under flanges with sixteen (16) of single flange travel wheels. Crane bridge is equipped with rack and pinion drive and driven by electrical explosion proof single speed motors with fail safe brakes through gear and pinion. Limit switches are installed on the crane in addition to heavy duty bumpers in each end of the runway beams.

Hoist machinery:

Crane is equipped with electrical wire hoist with four wire falls. The hoist motor is two speed of explosion proof design with fail safe brake. Overload switch and limit switches for top and bottom position are included. Wire drum grooved, and hoist is equipped with non-spark spooling device to ensure correct wire spooling on the drum. Wire rope is galvanized and of non-rotating type.

Trolley:

The trolley is running on 4 wheels. The trolley is provided with rack and pinion drive. Drive is by electrical explosion proof single speed motor with fail safe bake through gear and cross shaft. Limit switches are installed on the crane in addition to heavy duty bumpers in each end of the crane.

Redundancy Features

None.

Protection Features

- Limit switches bridge travel
- Overload switch
- Limit switch for hoist
- Limit switch for trolley
- Emergency stop

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07020
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07020	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

- Fail safe brakes

Key Control Features

Radio remote is utilized as main measure of control.

RCM – Systems analysis

Step 3-2:	System Description/FBD	Plant ID:	EKOM
Information:	Functional Block Diagram	System ID:	BD/EKOM/840/19 07020
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07020	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

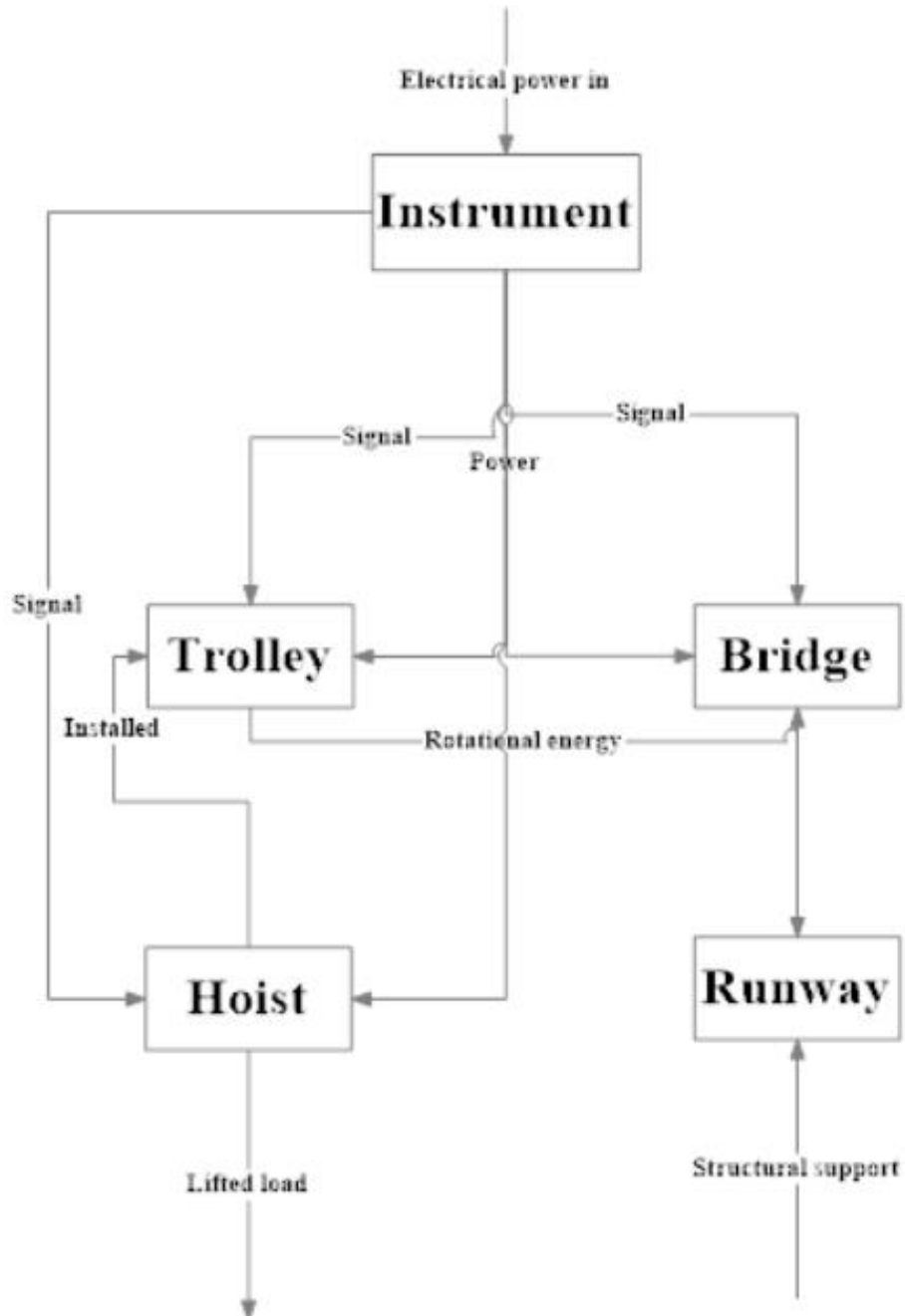


Figure 1 – Functional block diagram

RCM – Systems analysis

Step 3-3:	System Description/FBD	Plant ID:	EKOM
Information:	IN/OUT Interfaces	System ID:	BD/EKOM/840/19 07020
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07020	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Type	Bounding system	Interface location	Ref. drawing
IN (690V)	Instrument	28-00002-05C	E900-11915-E-00077
IN (Structural)	Runway	W30	E900-11915-M-0038
OUT (Energy)	Hoist	W30	E900-11915-M-0038

3-4 Work Breakdown Structure

No #	TAG No.	Description	System	Sub-system	Type (Instrument only)	Qty	Dwg or ref
1	19 07020	CRANE OVERHEAD TRAVELLING 15 T	All	-		1	E900-11915-M-00038
2		BUMPER	Bridge	Bumper		4	E900-11915-M-00038
3		CABLE LOOP	Bridge	Cable tray		1	E900-11915-M-00038
4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	Bridge	Crane drive		1	E900-11915-M-00038
5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	Bridge	Crane drive		1	E900-11915-M-00038
6		GEARBOX. MOTOR TRAVELLING	Bridge	Crane drive		1	E900-11915-M-00038
7		GEARBOX. MOTOR TRAVELLING	Bridge	Crane drive		1	E900-11915-M-00038
8		DRIVE PINION	Bridge	Crane drive		2	E900-11915-M-00038
9		TRAVEL WHEELS	Bridge	Travel wheels		16	E900-11915-M-00038
10		TROLLEY GEAR RACK	Bridge	Trolley gear rack		1	E900-11915-M-00038
11	30 07020	MOTOR HOIST. CRANE OVERHEAD	Hoist	Hoist drive		1	E900-11915-M-00038
12		GEARBOX MOTOR HOIST	Hoist	Hoist drive		1	E900-11915-M-00038
13		DRUM BEARINGS	Hoist	Hoist drive		2	E900-11915-M-00038
14	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	Hoist	Lower block		1	E900-11915-M-00038
15		UPPER BLOCK	Hoist	Upper block		1	E900-11915-M-00038
16	19 02818	WIRE 14 MM MIN BRUDD 20T	Hoist	Wire rope		1	E900-11915-M-00038
17		WIRE END CONNECTION OUTER	Hoist	Wire rope		1	E900-11915-M-00038
18		WIRE END CONNECTION	Hoist	Wire rope clamp		1	E900-11915-M-00038
19	28 JE-07020	BOX JUNCTION OVERHEAD CRANE 19 07020	Instrument	Junction box		1	E900-11915-E-00077
20	28 JE-07021	BOX JUNCTION OVERHEAD CRANE 19 07020	Instrument	Junction box		1	E900-11915-E-00077
21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00077
22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00077
23	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	Instrument	Limit switch hoist	Protection	1	E900-11915-E-00077
24	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	Instrument	Limit switch hoist	Protection	1	E900-11915-E-00077
25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00077
26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00077
27		OVERLOAD SWITCH HOIST	Instrument	Overload switch hoist	Protection	1	E900-11915-E-00077
28	28 07020	SWITCH MAIN FOR OVERHEAD CRANE 19 07020	Instrument	Pennant	Control	1	E900-11915-E-00077
29	28 07021	SWITCH PUSH BUTTON STATION FOR 19 07020	Instrument	Pennant	Control	1	E900-11915-E-00077
30	28 08295	SWITCH EMERG STOP CRANE 19 07020	Instrument	Pennant	Control	1	
31	LCP-07020	PANEL CONTROL OVERHEAD CRANE 19 07020	Instrument	Radio remote	Control	1	
32	19 07559	PADEYE TEST SWL 25T (FOR OT CRANE)	Other	-		1	
33		BRIDGE GEAR RACK	Runway	Runway beams		2	E900-11915-M-00038
34		RUNWAY BEAMS	Runway	Runway beams		2	E900-11915-M-00038
35		TROLLEY TRAVEL WHEELS	Trolley	Travelling wheels		4	E900-11915-M-00038
36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	Trolley	Trolley drive		1	E900-11915-M-00038
37		GEARBOX TROLLEY MOTOR	Trolley	Trolley drive		1	E900-11915-M-00038
38		PINION TROLLEY DRIVE	Trolley	Trolley drive		1	E900-11915-M-00038

3-5 Equipment history

Date	TAG No.	Description	System	Sub-system	Failure mode	Failure Cause
09.03.2009		Wire rope	Hoist	Wire rope	Dry	Insufficient lubrication
09.03.2009		Wire rope	Hoist	Other	Twisted	Unknown - Human error?
25.02.2010		Electrical protection device	Instrument	Electrical Protection Devices	Insufficient	Electrical motor protection device used on two motors.
13.03.2010		Overload switch hoist	Instrument	Overload switch	Incorrect setting	Unknown
28.06.2010		Brake cover	Hoist	Hoist drive	Corroded	Unknown - Environment?
14.03.2011		Bolts for travel wheel	Bridge	Travel wheels	Loose	Unknown - Vibrations?
11.03.2012		Chain	Trolley	Trolley drive	Loose	Unknown - Vibrations?
09.03.2013		Pendant	Instrument	Pendant	Unsecured	Unknown
19.06.2013		Parking	Other	Other	Missing	Unknown
15.03.2014		Overload switch hoist	Instrument	Overload switch	Incorrect setting	Unknown
15.03.2014		Wire rope	Hoist	Wire rope	Damaged	Unknown
22.08.2014		Wire rope	Hoist	Wire rope	Damaged	Unknown
09.09.2014	BD/EKOM/19 02817	Lower block	Hoist	Lower block	Worn	Unknown - Environment?
09.09.2014		Wire end connection	Hoist	Wire rope clamp	Damaged	Unknown
27.03.2015		Travel motors	Trolley	Trolley drive	Corroded	Unknown - Environment?
27.03.2015		Wire for pendant	Instrument	Pendant	Damaged	Unknown
24.11.2015		Electrical protection device	Instrument	Electrical Protection Devices	Incorrect setting	Unknown
04.03.2017	BD/EKOM/19 02818	Wire rope	Hoist	Wire rope	Wrong	Unknown
04.03.2017	BD/EKOM/28 08295	Emergency stop	Instrument	Pendant	Wrong	Unknown
04.03.2017		Cable trays	Trolley	Other	Damaged	Unknown
04.03.2017		Trolley gear rack	Bridge	Trolley gear rack	Corroded	Unknown - Environment?

4 Functional failure

Function #	FF #	Function/Functional failure
2		Dampen and mitigate collision if needed
	2.1	No damping of bridge
3		Hold the cables when the trolley is moving
	3.1	Cables fall of
	3.2	Cable loop snags in other structure
4		Transmit rotational forces through gearbox and drive pinion in order to move bridge
	4.1	Bridge stationary
5		Transmit rotational forces through gearbox and drive pinion in order to move bridge
	5.1	Bridge stationary
6		Transmit rotational forces from motor to drive pinion in order to move bridge
	6.1	Bridge stationary
7		Transmit rotational forces from motor to drive pinion in order to move bridge
	7.1	Bridge stationary
8		Transmit rotational forces from gearbox to gear rack in order to move bridge
	8.1	Bridge stationary
9		Support bridge on runway and enable smooth movement of bridge
	9.1	Load falling
	9.2	Bridge stationary
10		Enable smooth movement of the trolley
	10.1	Trolley stationary
11		Move load up and down, and hold load when stopped
	11.1	Hook stationary
	11.2	Load falling
12		Transmit rotational forces from motor to drum
	12.1	Hook stationary
	12.2	Load falling
13		Enable smooth rotation of drum and support drum
	13.1	Hook stationary
14		Move load up and down
	14.1	Hook stationary
	14.2	Load falling
15		Guide wire rope
	15.1	Hook stationary
	15.2	Load falling
16		Move the hook up and down

	16.1	Hook stationary
	16.2	Load falling
17		Hold the "dead" end of the wire rope
	17.1	Hook stationary
	17.2	Load falling
18		Hold the dead end of the wire rope on the drum
	18.1	Load falling
19		Hold the main electrical connections to the crane
	19.1	Crane without power
20		Hold the main electrical connections to the crane (secondary box)
	20.1	Crane without power
21		Limit crane bridge travel west
	21.1	Bridge stationary
	21.2	Bridge colliding
22		Limit crane bridge travel east
	22.1	Bridge stationary
	22.2	Bridge colliding
23		Limit hook traveling into the drum
	23.1	Hook stationary
	23.2	Hook pulled into the winch drum
24		Limit hook from touching the floor, slack wire
	24.1	Hook stationary
	24.2	Hook touching the floor, wire slack
25		Limit trolley travel north
	25.1	Trolley stationary
	25.2	Trolley colliding
26		Limit trolley travel south
	26.1	Trolley stationary
	26.2	Trolley colliding
27		Prevent the hoist from overloading the crane
	27.1	Hook stationary
	27.2	Crane overloaded
28		Hold the main power to the crane
	28.1	Crane without power
	28.2	Power will not turn off
29		Update the crane functions when radio control is disconnected (emergency operation)

	29.1	Bridge stationary
	29.2	Trolley stationary
	29.3	Hook stationary
	29.4	Crane stuck in high speed
	29.5	Crane stuck in low speed
	29.6	Crane will not stop
	29.7	Crane will not reset (All functions stationary)
30		Emergency stop all crane functions
	30.1	Crane not working
	30.2	Crane not stopping
31		Operate crane functions
	31.1	Bridge stationary
	31.2	Trolley stationary
	31.3	Hook stationary
	31.4	Crane will not stop
	31.5	Crane will not reset (All functions stationary)
32		Point of attaching crane for load testing. Holding load.
	32.1	Pulling out the load test point when applying load (Not holding the test load)
33		Enable smooth movement of the bridge
	33.1	Bridge stationary
34		Support the bridge
	34.1	Bridge falls down - Load falling
35		Support the trolley on the bridge and enable smooth movement
	35.1	Trolley stationary
	35.2	Trolley falls down - Load falling
36		Transmit rotational forces through gearbox and drive pinion in order to move trolley
	36.1	Trolley stationary
37		Transmit rotational forces from motor to pinion in order to move trolley
	37.1	Trolley stationary
38		Transmit rotational forces from gearbox to gir rack in order to move trolley
	38.1	Trolley stationary

5-1 Equipment-functional failure matrix

No.	TAG No.	Component description	Functional failures	2.1 No damping of bridge	3.1 Cables fall off	3.2 Cable loop snags in structure	4.1 Bridge stationary	9.1 Load falling	10.1 Trolley stationary	11.1 Hook stationary	19.1 Crane without power / Will not reset
2		BUMPER		X							
3		CABLE LOOP			3.2	X					
4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.					X				
5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.					X				
6		GEARBOX. MOTOR TRAVELLING					X				
7		GEARBOX. MOTOR TRAVELLING					X				
8		DRIVE PINION					X				
9		TRAVEL WHEELS					X	X			
10		TROLLEY GEAR RACK							X		
11	30 07020	MOTOR HOIST. CRANE OVERHEAD						X		X	
12		GEARBOX MOTOR HOIST						11.1		X	
13		DRUM BEARINGS								X	
14	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK						X		X	
15		UPPER BLOCK						X		X	
16	19 02818	WIRE 14 MM MIN BRUDD 20T						11.1		X	
17		WIRE END CONNECTION OUTER						11.1		X	
18		WIRE END CONNECTION						X			
19	28 JE-07020	BOX JUNCTION OVERHEAD CRANE 19 07020					11.1		11.1	X	11.1
20	28 JE-07021	BOX JUNCTION OVERHEAD CRANE 19 07020					11.1		11.1	X	11.1
21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020					X				
22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020					X				
23	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020								X	
24	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19								X	
25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020							X		
26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020							X		
27		OVERLOAD SWITCH HOIST								X	
28	28 07020	SWITCH MAIN FOR OVERHEAD CRANE 19 07020					11.1		11.1	X	11.1
29	28 07021	SWITCH PUSH BUTTON STATION FOR 19 07020					11.1		11.1	X	11.1
30	28 08295	SWITCH EMERG STOP CRANE 19 07020					11.1		11.1	X	11.1
31	LCP-07020	PANEL CONTROL OVERHEAD CRANE 19 07020					11.1		11.1	X	11.1
32	19 07559	PADEYE TEST SWL 25T (FOR OT CRANE)									
33		BRIDGE GEAR RACK					X				
34		RUNWAY BEAMS						X			
35		TROLLEY TRAVEL WHEELS						X	X		
36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020							X		
37		GEARBOX TROLLEY MOTOR							X		
38		PINION TROLLEY DRIVE							X		

5-2 FMEA

FF#	COMP	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Local	System	Plant	LTA
2.1	2		BUMPER	2.1	Brittle	2.1.1	Age	Broken bumpers	Limited damping of bridge if collision	None imidiate	No
3.2	3		CABLE LOOP	3.1	Broken	3.1.1	Snagging in structures	Cables could be broken	No connection with motors or instruments	Material handling not possible	Yes
4.1	4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	4.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	4.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	4.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	5.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	5.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	5.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	6		GEARBOX. MOTOR TRAVELLING	6.1	Gearbox not rotating	6.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
4.1	7		GEARBOX. MOTOR TRAVELLING	7.1	Gearbox not rotating	7.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
4.1	8		DRIVE PINION	8.1	Drive pinion not rotating	8.1.1	Broken theets	No movent on rack drive	Bridge travel restricted	Material handling not possible	Yes
4.1	9		TRAVEL WHEELS	9.1	Deformed	9.1.1	Bearing failure	Limited movement	Bridge travel restricted	Material handling not possible	Yes
4.1	21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	21.1.1	Age	Limit switch activated	Bridge travel restricted west direction	Moving the crane south is not possible	Yes
4.1	21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	21.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted west direction	Moving the crane south is not possible	Yes
4.1	21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.2	Broken	21.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted west direction	Moving the crane south is not possible	Yes
4.1	22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	22.1.1	Age	Limit switch activated	Bridge travel restricted east direction	Moving the crane north is not possible	Yes
4.1	22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	22.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted east direction	Moving the crane north is not possible	Yes
4.1	22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.2	Broken	22.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted east direction	Moving the crane north is not possible	Yes
4.1	33		BRIDGE GEAR RACK	33.1	Broken	33.1.1	Missing rack theets	No contact between pinion and rack	Bridge travel restricted	Material handling not possible	Yes
9.1	9		TRAVEL WHEELS	9.2	Structural failure	9.2.1	Massive degredation to structure	Overload of existing structure.	Bridge collapse	Crane collapse	Yes
9.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	11.4.1	Wear and tear	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	14	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	14.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	15		UPPER BLOCK	15.2	Severe structural corrosion	15.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	18		WIRE END CONNECTION	18.1	Severe structural corrosion	18.1.1	Lack of sufficient cross section	Not holding load if the wire is run of the drum	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	34		RUNWAY BEAMS	34.1	Severe structural corrosion	34.1.1	Lack of sufficient cross section in structural supports	Not holding load	Crane runway falling down	Crane collapse	Yes
9.1	35		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	35.1.1	Lack of sufficient cross section in axle	Not holding load	Trolley boogie falling down	Trolley collapse	Yes
10.1	10		TROLLEY GEAR RACK	10.1	Broken	10.1.1	Missing rack theets	No contact between pinion and rack	Trolley travel restricted	Material handling not possible	Yes
10.1	25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	25.1.1	Age	Not possible to move the trolley in north direction	Trolley travel restricted north	Material handling limited	Yes
10.1	25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	25.1.2	Dirt activating the switch	Not possible to move the trolley in north direction	Trolley travel restricted north	Material handling limited	Yes
10.1	25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.2	Broken	25.2.1	Moisture in the electronics	Not possible to move the trolley in north direction	Trolley travel restricted north	Material handling limited	Yes
10.1	26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	26.1.1	Age	Not possible to move the trolley in south direction	Trolley travel restricted south	Material handling limited	Yes
10.1	26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	26.1.2	Dirt activating the switch	Not possible to move the trolley in south direction	Trolley travel restricted south	Material handling limited	Yes
10.1	26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.2	Broken	26.2.1	Moisture in the electronics	Not possible to move the trolley in south direction	Trolley travel restricted south	Material handling limited	Yes

10.1	35		TROLLEY TRAVEL WHEELS	35.1	Deformed	35.1.1	Bearing failure	Limited movement	Trolley travel restricted	Material handling not possible	Yes
10.1	36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.1	Motor bearing defective	36.1.1	Insufficient lubrication	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
10.1	36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.2	Motor cage or rotor defective	36.2.1	Age	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
10.1	36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.3	Brake not releasing	36.3.1	Worn brake	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
10.1	37		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	37.1.1	Broken gears	No movement in output axle	Trolley travel restricted	Material handling not possible	Yes
10.1	38		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	38.1.1	Broken theets	No movent on rack drive	Trolley travel restricted	Material handling not possible	Yes
11.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	11.1.1	Insufficient lubrication	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
11.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	11.2.1	Age	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
11.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	11.3.1	Worn brake	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
11.1	12		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	12.1.1	Broken gears	No movement in output axle	Hoist movement restricted	Material handling not possible	Yes
11.1	13		DRUM BEARINGS	13.1	Bearing failure	13.01.2001	Insufficient lubrication	Bearing failure	Hoist movement restricted	Material handling not possible	Yes
11.1	14	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	14.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
11.1	15		UPPER BLOCK	15.1	Corrosion in bearings	15.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
11.1	16	19 02818	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	16.1.1	Broken because of severe missuse or deterioration	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
11.1	16	19 02818	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	16.2.1	Lack of lubrication	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
11.1	17		WIRE END CONNECTION OUTER	17.1	Broken	17.1.1	Broken because of severe missuse or deterioration	No end connection able to hold the load.	Hook movement restricted	Material handling not possible	Yes
11.1	19	28 JE-07020	BOX JUNCTION OVERHEAD CRANE 19 07020	19.1	Shorted	19.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
11.1	20	28 JE-07021	BOX JUNCTION OVERHEAD CRANE 19 07020	20.1	Shorted	20.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
11.1	23	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.1	False indication	23.1.1	Age	Limit switch activated	Could give restrictions for how high a load can be lifted	None imidiate	Yes
11.1	23	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.2	Incorrect setting	23.2.1	Unkown	Limit switch activated	Could give restrictions for how high a load can be lifted	None imidiate	Yes
11.1	24	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	23.1	False indication	23.1.1	Age	Limit switch activated	Could give restrictions for how low the hook can be louvered	None imidiate	Yes
11.1	24	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	23.2	Incorrect setting	23.2.1	Unkown	Limit switch activated	Could give restrictions for how low the hook can be louvered	None imidiate	Yes
11.1	27		OVERLOAD SWITCH HOIST	27.1	False indication	27.1.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
11.1	27		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	27.2.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
11.1	28	28 07020	SWITCH MAIN FOR OVERHEAD CRANE 19 07020	28.1	Shorted	28.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
11.1	29	28 07021	SWITCH PUSH BUTTON STATION FOR 19 07020	29.1	Shorted	29.1.1	Shorted because of moisture	Hoist control function not working	Hoisting restricted	Material handling not possible	Yes
11.1	30	28 08295	SWITCH EMERG STOP CRANE 19 07020	30.1	Shorted	30.1.1	Shorted because of moisture	Not possible to start the crane	Not possible to start the crane	Material handling not possible	Yes

6-1 LTA

FF#	COMP	TAG	Component Description	FM#	Failure Mode	Evident?	Safety	Outage	Cat	Comment
3.2	3		CABLE LOOP	3.1	Broken	Yes	No	Yes	B	Could stop the whole crane
4.1	4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	Yes	No	Yes	B	
4.1	4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	Yes	No	Yes	B	
4.1	4	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	Yes	No	Yes	B	
4.1	5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	Yes	No	Yes	B	
4.1	5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	Yes	No	Yes	B	
4.1	5	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	Yes	No	Yes	B	
4.1	6		GEARBOX. MOTOR TRAVELLING	6.1	Gearbox not rotating	Yes	No	Yes	B	
4.1	7		GEARBOX. MOTOR TRAVELLING	7.1	Gearbox not rotating	Yes	No	Yes	B	
4.1	8		DRIVE PINION	8.1	Drive pinion not rotating	Yes	No	Yes	B	
4.1	9		TRAVEL WHEELS	9.1	Deformed	Yes	No	Yes	B	
4.1	21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	Yes	Yes		A	
4.1	21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	Yes	Yes		A	
4.1	21	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.2	Broken	Yes	Yes		A	
4.1	22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	Yes	Yes		A	
4.1	22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	Yes	Yes		A	
4.1	22	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.2	Broken	Yes	Yes		A	
4.1	33		BRIDGE GEAR RACK	33.1	Broken	Yes	No	Yes	B	
9.1	9		TRAVEL WHEELS	9.2	Structural failure	Yes	Yes		A	
9.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	Yes	Yes		A	
9.1	14	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	Yes	Yes		A	
9.1	15		UPPER BLOCK	15.2	Severe structural corrosion	Yes	Yes		A	
9.1	18		WIRE END CONNECTION	18.1	Severe structural corrosion	Yes	Yes		A	
9.1	34		RUNWAY BEAMS	34.1	Severe structural corrosion	Yes	Yes		A	
9.1	35		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	Yes	Yes		A	
10.1	10		TROLLEY GEAR RACK	10.1	Broken	Yes	No		B	
10.1	25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	Yes	Yes		A	
10.1	25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	Yes	Yes		A	
10.1	25	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.2	Broken	Yes	Yes		A	
10.1	26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	Yes	Yes		A	
10.1	26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	Yes	Yes		A	
10.1	26	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.2	Broken	Yes	Yes		A	
10.1	35		TROLLEY TRAVEL WHEELS	35.1	Deformed	Yes	Yes		A	

10.1	36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.1	Motor bearing defective	Yes	No	Yes	B	
10.1	36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.2	Motor cage or rotor defective	Yes	No	Yes	B	
10.1	36	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.3	Brake not releasing	Yes	No	Yes	B	
10.1	37		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	Yes	No	Yes	B	
10.1	38		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	Yes	No	Yes	B	
11.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	Yes	Yes		A	
11.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	Yes	Yes		A	
11.1	11	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	Yes	Yes		A	
11.1	12		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	Yes	Yes		A	
11.1	13		DRUM BEARINGS	13.1	Bearing failure	Yes	No	Yes	B	
11.1	14	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	Yes	Yes		A	
11.1	15		UPPER BLOCK	15.1	Corrosion in bearings	Yes	Yes		A	
11.1	16	19 02818	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	Yes	Yes		A	
11.1	16	19 02818	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	Yes	Yes		A	
11.1	17		WIRE END CONNECTION OUTER	17.1	Broken	Yes	Yes		A	
11.1	19	28 JE-07020	BOX JUNCTION OVERHEAD CRANE 19 07020	19.1	Shorted	Yes	No	Yes	B	
11.1	20	28 JE-07021	BOX JUNCTION OVERHEAD CRANE 19 07020	20.1	Shorted	Yes	No	Yes	B	
11.1	23	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.1	False indication	Yes	Yes		A	
11.1	23	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.2	Incorrect setting	Yes	Yes		A	
11.1	24	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	23.1	False indication	Yes	Yes		A	
11.1	24	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	23.2	Incorrect setting	Yes	Yes		A	
11.1	27		OVERLOAD SWITCH HOIST	27.1	False indication	Yes	Yes		A	
11.1	27		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	Yes	Yes		A	
11.1	28	28 07020	SWITCH MAIN FOR OVERHEAD CRANE 19 07020	28.1	Shorted	Yes	No	Yes	B	
11.1	29	28 07021	SWITCH PUSH BUTTON STATION FOR 19 07020	29.1	Shorted	Yes	No	Yes	B	
11.1	30	28 08295	SWITCH EMERG STOP CRANE 19 07020	30.1	Shorted	Yes	Yes		A	
11.1	31	LCP-07020	PANEL CONTROL OVERHEAD CRANE 19 07020	31.1	Shorted	Yes	Yes		A	
32.1	32	19 07559	PADEYE TEST SWL 25T (FOR OT CRANE)	32.1	Overstress	Yes	Yes		A	

7-1 Task selection

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Cat	1	2	3	4	5	6	7	Candidate Task	Effective Info	Selective dec.	Est Freq.
9.1	9	Bridge		TRAVEL WHEELS	9.2	Structural failure	9.2.1	Massive degradation to structure	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
3.2	3	Bridge		CABLE LOOP	3.1	Broken	3.1.1	Snagging in structures	B	P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation - TD	1Y
4.1	4	Bridge	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	4.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun - TD	4Y
4.1	4	Bridge	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	4.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
4.1	4	Bridge	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	4.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
4.1	5	Bridge	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	5.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
4.1	5	Bridge	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	5.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
4.1	5	Bridge	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	5.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
4.1	6	Bridge		GEARBOX, MOTOR TRAVELLING	6.1	Gearbox not rotating	6.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
4.1	7	Bridge		GEARBOX, MOTOR TRAVELLING	7.1	Gearbox not rotating	7.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
4.1	8	Bridge		DRIVE PINION	8.1	Drive pinion not rotating	8.1.1	Broken theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
4.1	9	Bridge		TRAVEL WHEELS	9.1	Deformed	9.1.1	Bearing failure	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	10	Bridge		TROLLEY GEAR RACK	10.1	Broken	10.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
9.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	11.4.1	Wear and tear	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	11.1.1	Insufficient lubrication	A	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
11.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	11.2.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
11.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	11.3.1	Worn brake	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	12	Hoist		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	12.1.1	Broken gears	A	P	Y	N	N	-	Y	-	1. Verify oil level - TD 2. Change oil - TD		1. Verify oil level - TD 2. Change oil - TD	1, 1Y 2, 4Y
9.1	14	Hoist	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	14.2.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	14	Hoist	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	14.1.1	Water penetration in bearings.	A	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M
9.1	15	Hoist		UPPER BLOCK	15.2	Severe structural corrosion	15.2.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	15	Hoist		UPPER BLOCK	15.1	Corrosion in bearings	15.1.1	Water penetration in bearings.	A	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M

11.1	16	Hoist	19 02818	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	16.1.1	Broken because of severe missuse or deterioration	A	Y	Y	N	N	-	Y	-	1. Inspect wire rope 2. Change wire rope	To achieve a reliability rate of 80,42% the wire rope should be changed every 150days. MTBF = 1360 days	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 1Y
11.1	16	Hoist	19 02818	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	16.2.1	Lack of lubrication	A	P	Y	N	N	-	Y	-	1. Inspect wire rope 2. Lubricate wire rope		1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M
11.1	17	Hoist		WIRE END CONNECTION OUTER	17.1	Broken	17.1.1	Broken because of severe missuse or deterioration	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
9.1	18	Hoist		WIRE END CONNECTION	18.1	Severe structural corrosion	18.1.1	Lack of sufficient cross section	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	13	Hoist		DRUM BEARINGS	13.1	Bearing failure	13.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	1Y
4.1	21	Instrument	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	21.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	21	Instrument	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	21.1.2	Dirt activating the switch	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	21	Instrument	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.2	Broken	21.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Effectively OEM is refering to IEC 60079-17, which in terms are giving instructions to inspect at least every 3Y. 1Y is based on analysts personal experience of the build-up of moisture in JB offshore.	1. Inspect and clean - TD	1Y
4.1	22	Instrument	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	22.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	22	Instrument	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	22.1.2	Dirt activating the switch	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	22	Instrument	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.2	Broken	22.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	23	Instrument	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.1	False indication	23.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	23	Instrument	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.2	Incorrect setting	23.2.1	Unkown	A	P	Y	N	N	-	Y	-	1. Verify limits		1. Verify limits	3M
11.1	24	Instrument	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	23.1	False indication	23.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	24	Instrument	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	23.2	Incorrect setting	23.2.1	Unkown	A	P	Y	N	N	-	Y	-	1. Verify limits		1. Verify limits	3M
10.1	25	Instrument	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	25.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	25	Instrument	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	25.1.2	Dirt activating the switch	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	25	Instrument	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.2	Broken	25.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	26	Instrument	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	26.1.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	26	Instrument	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	26.1.2	Dirt activating the switch	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	26	Instrument	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.2	Broken	26.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.1	False indication	27.1.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y

11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	27.2.1	Moisture in the electronics	A	P	Y	N	N	-	Y	-	1. Verify limits	Part of annual control. One will need to exceed 3 years to get a reliability rate below 90%. MTBF: 1498days	1. Verify limits	1Y
11.1	30	Instrument	28 08295	SWITCH EMERG STOP CRANE 19 07020	30.1	Shorted	30.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	31	Instrument	LCP-07020	PANEL CONTROL OVERHEAD CRANE 19 07020	31.1	Shorted	31.1.1	Shorted because of moisture	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	19	Instrument	28 JE-07020	BOX JUNCTION OVERHEAD CRANE 19 07020	19.1	Shorted	19.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	20	Instrument	28 JE-07021	BOX JUNCTION OVERHEAD CRANE 19 07020	20.1	Shorted	20.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	28	Instrument	28 07020	SWITCH MAIN FOR OVERHEAD CRANE 19 07020	28.1	Shorted	28.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	29	Instrument	28 07021	SWITCH PUSH BUTTON STATION FOR 19 07020	29.1	Shorted	29.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
32.1	32	Other	19 07559	PADEYE TEST SWL 25T (FOR OT CRANE)	32.1	Overstress	32.1.1	Tear out due to loss of cross section	A	P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation - TD	1Y
9.1	34	Runway		RUNWAY BEAMS	34.1	Severe structural corrosion	34.1.1	Lack of sufficient cross section in structural supports	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
4.1	33	Runway		BRIDGE GEAR RACK	33.1	Broken	33.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
9.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	35.1.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Deformed	35.1.1	Bearing failure	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	36	Trolley	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.1	Motor bearing defective	36.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
10.1	36	Trolley	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.2	Motor cage or rotor defective	36.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
10.1	36	Trolley	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.3	Brake not releasing	36.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	37	Trolley		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	37.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
10.1	38	Trolley		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	38.1.1	Broken theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	2 995	3	0,794117647	0,457709854	8,004699511
2	160	1	0,205882353	-1,467401781	5,075173815
3	925	2	0,5	-0,366512921	6,829793738
4					
5					
6					
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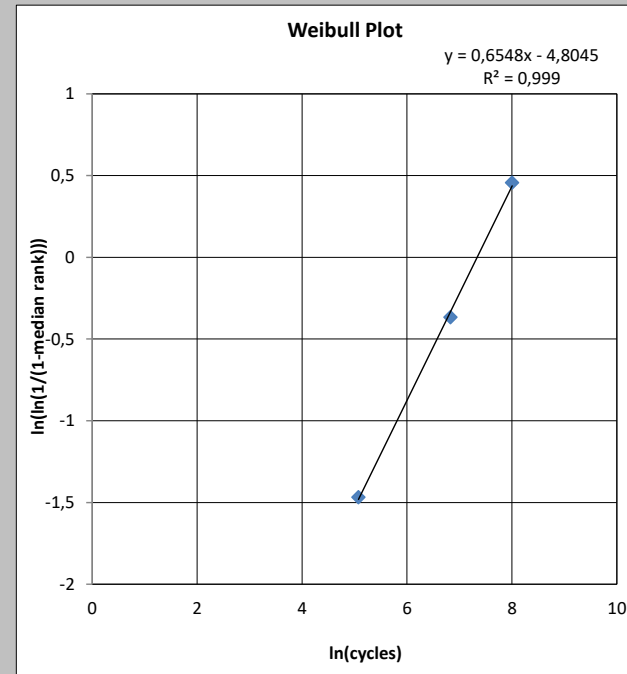
Enter the minimum number of cycles you desire the product to achieve: 150

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 0,65

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 1 536

Reliability at 150 cycles 80,42 %



Conclusions:

The product will meet or exceed the desired reliability of 80 percent at 150 cycles.

The Shape Parameter, Beta, is less than 1 indicating that the product is experiencing infant life failure rate

Weibull Analysis

	Enter the number of cycles	Rank	Median Rank	$\ln(\ln(1/(1-\text{median rank})))$	$\ln(\text{cycles})$
1	1 532	2	0,708333333	0,208755483	7,33432935
2	1 463	1	0,291666667	-1,064673327	7,288244401
3					
4					
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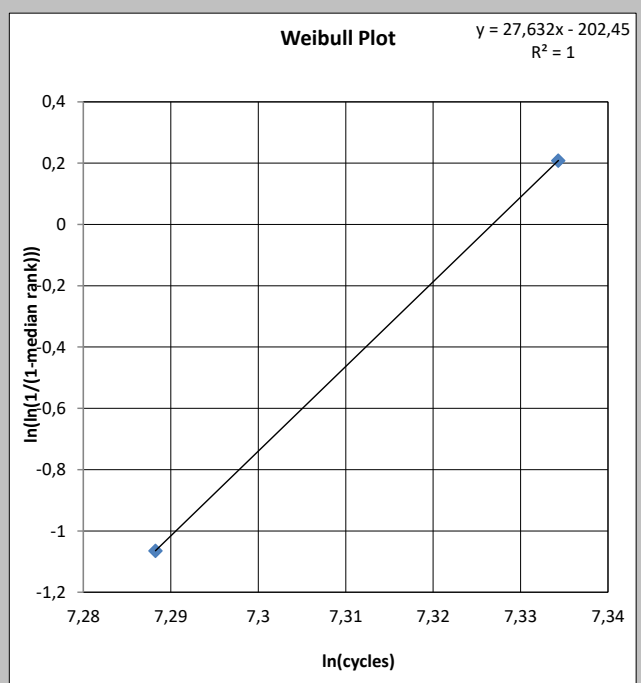
Enter the minimum number of cycles you desire the product to achieve: 1 460

Enter the percentage of product you wish to survive the desired number of cycles: 80 %

Shape Parameter, Beta: Infant life failures (< 1), wearing out (> 1), or constant failure rate (= 1) 27,63

Characteristic Life, Alpha: The number of cycles at which 63.2% of the product will fail 1 520

Reliability at 1460 cycles 72,20 %



Conclusions:

The product will not meet the desired reliability of 80 percent at 1460 cycles.

The Shape Parameter, Beta, is greater than 1 indicating that the product is experiencing normal wear out failure rate

7-2 Sanity check

FF#	Comp #	TAG	Component Description	FM#	Failure mode	1	2	3	4	5	6	7	8	RTF	Selection Dec	Est Freq	Comments
2.1	2		BUMPER	2.1	Brittle	N	N	N	N	N	N	N	N	RTF	RTF		

7-3 Task comparison

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	RCM Selective dec.	Est Freq.	Current Task	Freq.
2.1	2	Bridge		Bumper	2.1	Brittle	RTF			
3.2	3	Bridge		CABLE LOOP	3.1	Broken	1. Check for wear and tear or deformation - TD	1Y	WS-19OVER30. M	6M
4.1	4	Bridge	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
4.1	4	Bridge	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
4.1	4	Bridge	30 07022	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	1. Inspect and clean - TD	1Y		
4.1	5	Bridge	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
4.1	5	Bridge	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
4.1	5	Bridge	30 07023	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	1. Inspect and clean - TD	1Y		
4.1	6	Bridge		GEARBOX. MOTOR TRAVELLING	6.1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER46. M	4Y
4.1	7	Bridge		GEARBOX. MOTOR TRAVELLING	7.1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER46. M	4Y
4.1	8	Bridge		DRIVE PINION	8.1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER46. M	1Y
9.1	9	Bridge		TRAVEL WHEELS	9.2	Structural failure	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	9	Bridge		TRAVEL WHEELS	9.1	Deformed	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	10	Bridge		TROLLEY GEAR RACK	10.1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER46. M	1Y
9.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	1. Inspect and clean - TD	1Y		
11.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
11.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
11.1	11	Hoist	30 07020	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	1. Inspect and clean - TD	1Y	WS-19OVER33. M	6M
11.1	12	Hoist		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	1. Verify oil level - TD 2. Change oil - TD	1. 1Y 2. 4Y	WS-19OVER46. M	4Y
11.1	13	Hoist		DRUM BEARINGS	13.1	Bearing failure	1. Lubricate with grease gun. - TD	1Y		

9.1	14	Hoist	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
11.1	14	Hoist	19 02817	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M	WS-19OVER59.M	3M
9.1	15	Hoist		UPPER BLOCK	15.2	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
11.1	15	Hoist		UPPER BLOCK	15.1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M	WS-19OVER59.M	3M
11.1	16	Hoist	19 02818	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 1Y	WS-19OVER59.M	3M
11.1	16	Hoist	19 02818	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M	WS-19OVER59.M	3M
11.1	17	Hoist		WIRE END CONNECTION OUTER	17.1	Broken	1. Inspect and clean - TD	1Y	WS-19OVER59.M	3M
9.1	18	Hoist		WIRE END CONNECTION	18.1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
11.1	19	Instrument	28 JE-07020	BOX JUNCTION OVERHEAD CRANE 19 07020	19.1	Shorted	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
11.1	20	Instrument	28 JE-07021	BOX JUNCTION OVERHEAD CRANE 19 07020	20.1	Shorted	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
4.1	21	Instrument	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
4.1	21	Instrument	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
4.1	21	Instrument	ZS-01866	SWITCH POS TRAVEL OVERH CRANE 19 07020	21.2	Broken	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
4.1	22	Instrument	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
4.1	22	Instrument	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
4.1	22	Instrument	ZS-01867	SWITCH POS TRAVEL OVERH CRANE 19 07020	22.2	Broken	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
11.1	23	Instrument	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
11.1	23	Instrument	ZS-01862	SW LIMIT POS HOOK TOP OVERH CRANE 19 07020	23.2	Incorrect setting	1. Verify limits	3M	WS-19OVER30.M	6M

11.1	24	Instrument	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	24.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	24	Instrument	ZS-01863	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07020	24.2	Incorrect setting	1. Verify limits	3M	WS-19OVER30. M	6M
10.1	25	Instrument	ZS-01864	SWITCH POS TROLLY OVERH CRANE 19 07020	25.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	26	Instrument	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	26	Instrument	ZS-01865	SWITCH POS TROLLY OVERH CRANE 19 07020	26.2	Broken	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER33. M	6M
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	1. Verify limits	1Y	WS-19OVER33. M	6M
11.1	28	Instrument	28 07020	SWITCH MAIN FOR OVERHEAD CRANE 19 07020	28.1	Shorted	1. Inspect and clean - TD	1Y		
11.1	29	Instrument	28 07021	SWITCH PUSH BUTTON STATION FOR 19 07020	29.1	Shorted	1. Inspect and clean - TD	1Y		
11.1	30	Instrument	28 08295	SWITCH EMERG STOP CRANE 19 07020	30.1	Shorted	1. Inspect and clean - TD			
11.1	31	Instrument	LCP-07020	PANEL CONTROL OVERHEAD CRANE 19 07020	31.1	Shorted	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
32.1	32	Other	19 07559	PADEYE TEST SWL 25T (FOR OT CRANE)	32.1	Overstress	1. Check for wear and tear or deformation - TD	1Y		
4.1	33	Runway		BRIDGE GEAR RACK	33.1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER30. M	6M
9.1	34	Runway		RUNWAY BEAMS	34.1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
9.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Deformed	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	36	Trolley	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
10.1	36	Trolley	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
10.1	36	Trolley	30 07021	MOTOR TROLLEY. CRANE OVERHEAD 19 07020	36.3	Brake not releasing	1. Inspect and clean - TD	1Y		

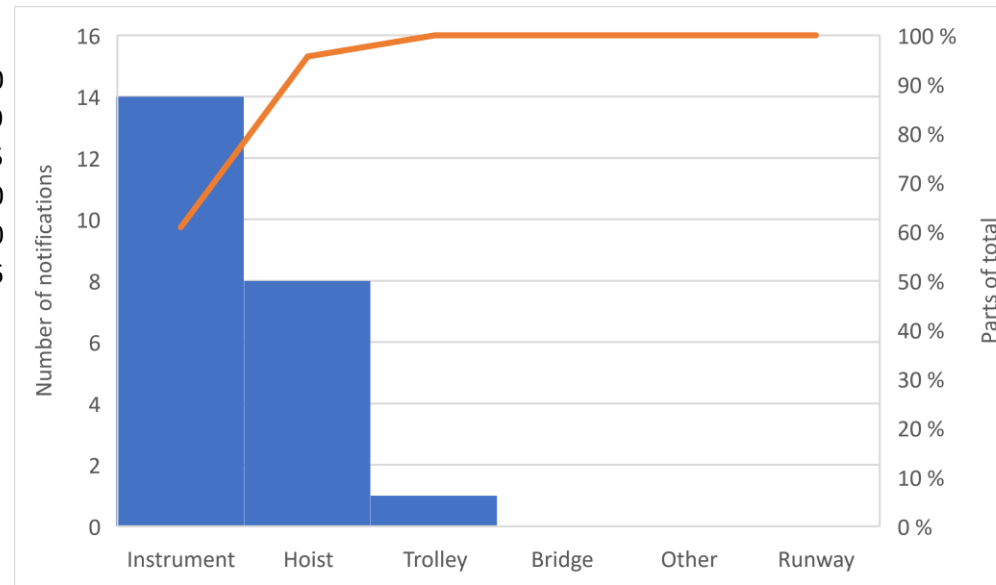
10.1	37	Trolley		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER46. M	4Y
10.1	38	Trolley		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER46. M	1Y

Complete Analysis
TAG NO. 07025

1-1 Notifications and history

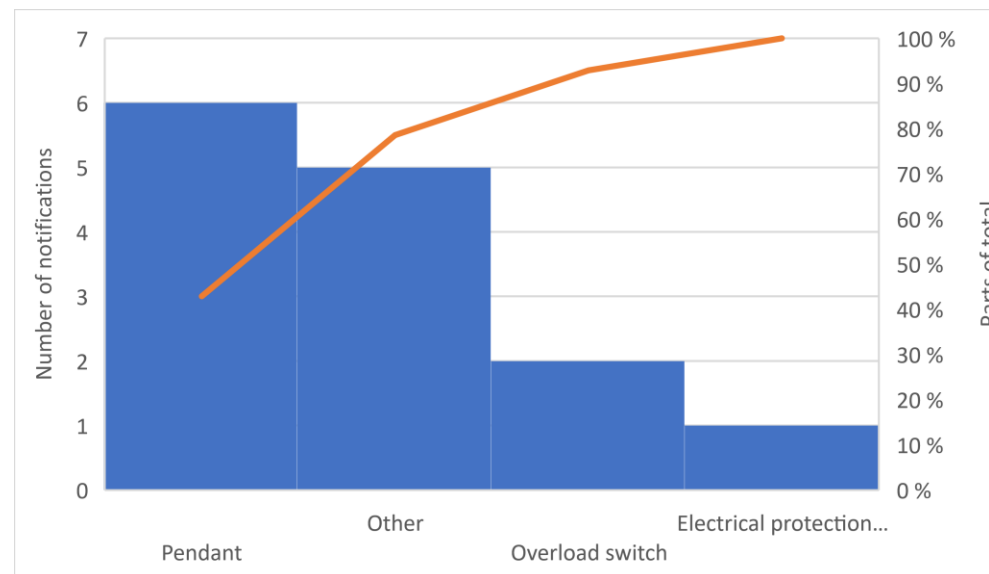
Overall

Bridge	0	0
Hoist	8	0,34782609
Instrument	14	0,60869565
Other	0	0
Runway	0	0
Trolley	1	0,04347826
Totalt minus k	23	
Kanselert	3	
Totalt	26	
Opptelling fra	26	



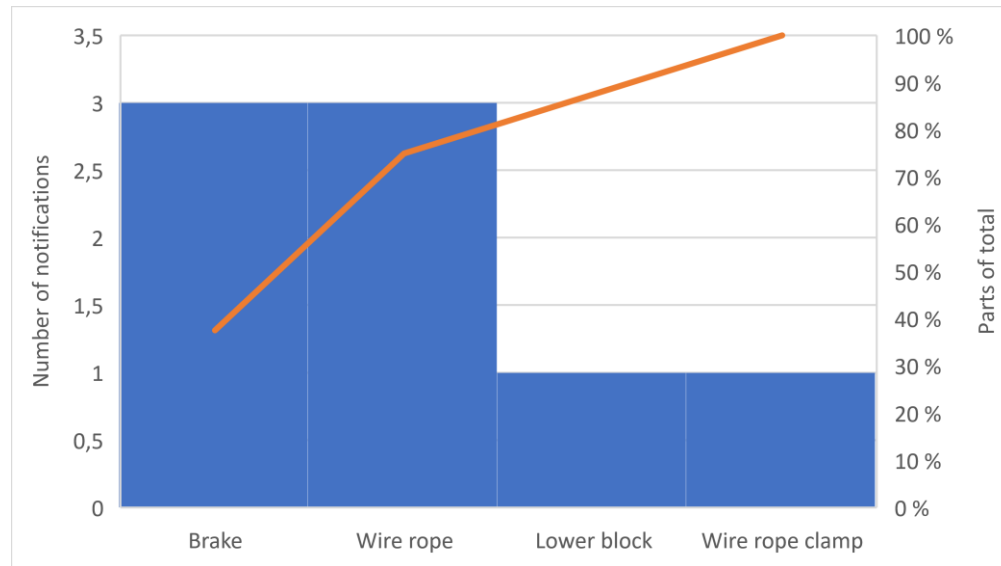
Instrument

Instrument	14	
Electrical prot	1	0,07142857
Overload swit	2	0,14285714
Pendant	6	0,42857143
Other	5	0,35714286



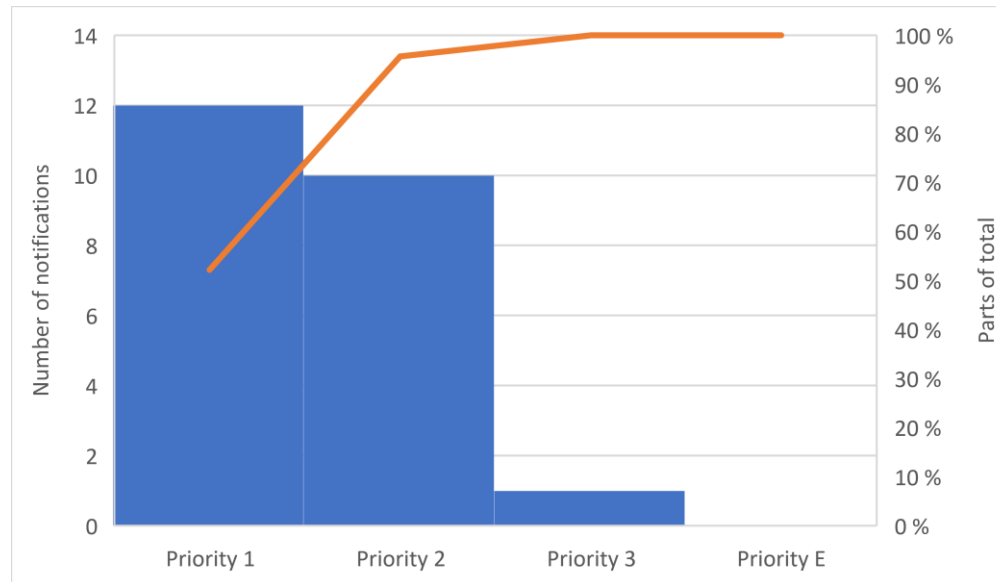
Hoist

Hoist	8	
Brake	3	0,375
Lower block	1	0,125
Wire rope	3	0,375
Wire rope clar	1	0,125



Priority

Priority	23	
Priority E	0	0
Priority 1	12	0,52173913
Priority 2	10	0,43478261
Priority 3	1	0,04347826



RCM – Systems analysis

Step 2-1:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Overview	System ID:	BD/EKOM/840/19 07025
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07025	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Major Equipment Included:

Bridge:

- Girder main assembly – C654-101
- Gearbox traveling motors N/S – ET3010/MR1
- Traveling motors N/S – DB35 90S4 0,87kW
- Travelling wheels
- Cable loop arrangement – S1-E 312391
- Drive pinions

Hoist:

- Motor hoist – PB35 200LB412 13/4,4kW
- Hoist Gearbox – ET3065/MR1
- Wire rope Ø14mm x 50m
- Lower block – P59-99
- Upper block – P59-138

Instrument:

- Radio remote – HBC FST 735-09-1315-C
- Limit switches – 1S5, 1S6, 2S5, 2S6, 3S5, 3S6 – NCN20+U1+NO Pepperl & Fuchs
- Overload switch – 3S9 – ZS 336 – 11Z Schmersal

Runway:

- Runway beams
- Runway bridge travel racks

Trolley:

- Motor travel – DB35 90S4 0,87kW
- Gearbox – A412 UR F1A
- Travelling pinions – L43-4-023 U047
- Travelling Wheels – B30-121

Primary Physical Boundaries

Start with:

Main electrical supply 3x690V 60Hz – FROM: 28-00002-05D

Supports for runway beams

Terminate with:

Lifted load. Attached in crane hook.

Caveats:

N/A

RCM – Systems analysis

Step 2-2:	System Boundary Definition	Plant ID:	EKOM
Information:	Boundary Details	System ID:	BD/EKOM/840/19 07025
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07025	Date:	08.04.2018
Subsystem:			
Analyst	Øystein Refsland Andreassen		

Type	Bounding System	Interface Location	Ref. Drawing
IN (Electrical)	Instrument	28-00002-05D	E900-11915-E-00077
IN (Structural support)	Runway	W30	E900-11915-M-0038
OUT (Load)	Hoist	W30	E900-11915-M-0038

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07025
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07025	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Functional Description/Key Parameters

The Electrical Overhead Travelling Cranes are of underslung monobox special design for Ekofisk platform, 2/4M module W30.

Main Girder is made as box of plates and the end trucks are made of channel profiles and steel plates.

Cranes are made for Zone 1 hazardous area. All el. equipment designed for Zone 1.

The cranes are for offshore installations with ambient temperature -20 deg C.

following main data:

Capacity: 15T

Span: 6000 mm

Height of lift: 10 m

Hoisting speed: 3,6/0,9 m/min (two speed)

Trolley speed: 6 m/min

Crane speed: 6 m/min

Power supply: 690V/60Hz/3ph

Heel: 1 deg.

Runway beams: HE260M

Further according to GA dwg. No.: E900-11915-M-00007-001

Crane bridge:

The crane bridge is running on runway beams under flanges with sixteen (16) of single flange travel wheels. Crane bridge is equipped with rack and pinion drive and driven by electrical explosion proof single speed motors with fail safe brakes through gear and pinion. Limit switches are installed on the crane in addition to heavy duty bumpers in each end of the runway beams.

Hoist machinery:

Crane is equipped with electrical wire hoist with four wire falls. The hoist motor is two speed of explosion proof design with fail safe brake. Overload switch and limit switches for top and bottom position are included. Wire drum grooved, and hoist is equipped with non-spark spooling device to ensure correct wire spooling on the drum. Wire rope is galvanized and of non-rotating type.

Trolley:

The trolley is running on 4 wheels. The trolley is provided with rack and pinion drive. Drive is by electrical explosion proof single speed motor with fail safe bake through gear and cross shaft. Limit switches are installed on the crane in addition to heavy duty bumpers in each end of the crane.

Redundancy Features

None.

Protection Features

- Limit switches bridge travel
- Overload switch
- Limit switch for hoist
- Limit switch for trolley
- Emergency stop

RCM – Systems analysis

Step 3-1:	System Description/FBD	Plant ID:	EKOM
Information:	System Description	System ID:	BD/EKOM/840/19 07025
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07025	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

- Fail safe brakes

Key Control Features

Radio remote is utilized as main measure of control.

RCM – Systems analysis

Step 3-2:	System Description/FBD	Plant ID:	EKOM
Information:	Functional Block Diagram	System ID:	BD/EKOM/840/19 07025
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07025	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

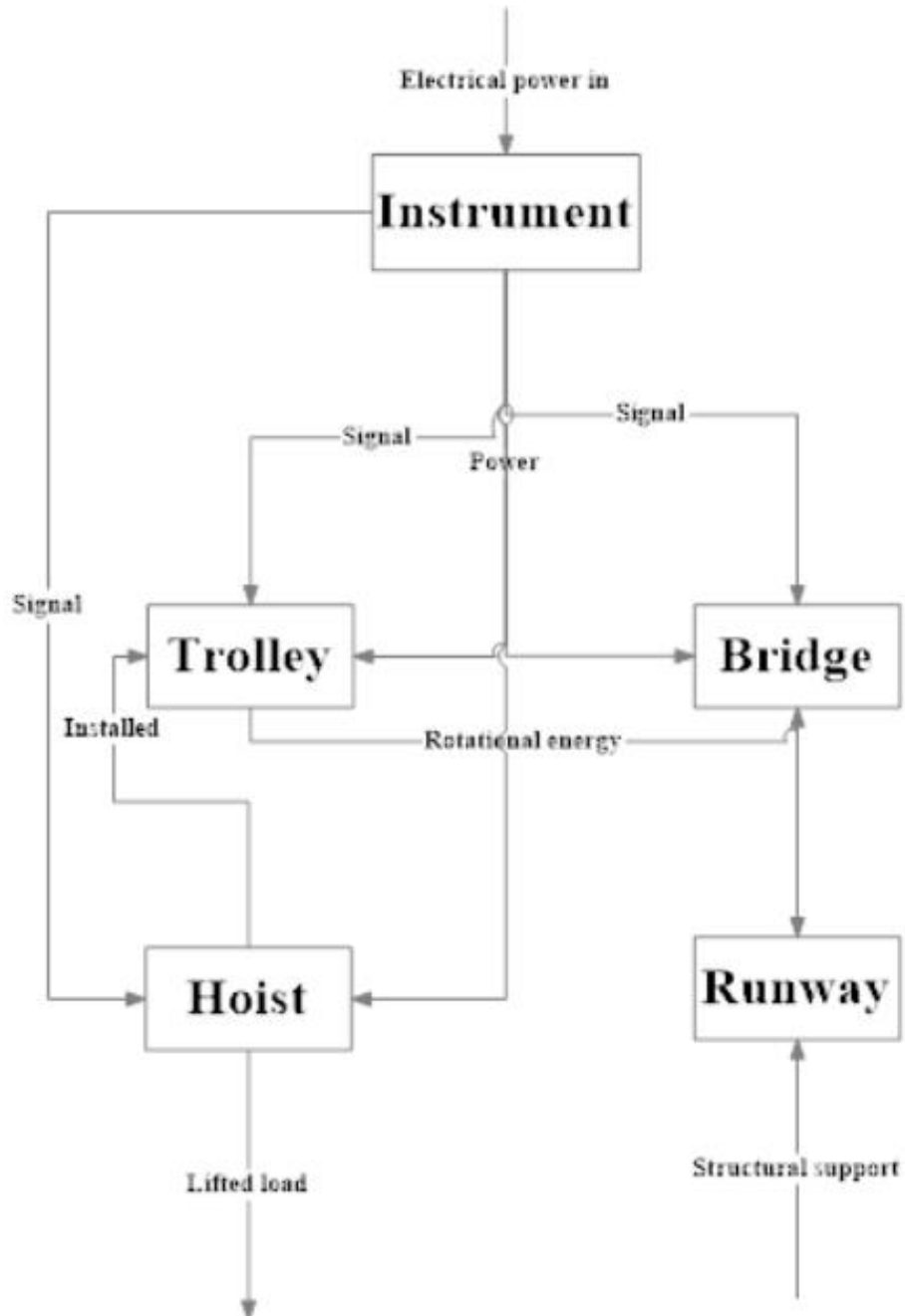


Figure 1 – Functional block diagram

RCM – Systems analysis

Step 3-3:	System Description/FBD	Plant ID:	EKOM
Information:	IN/OUT Interfaces	System ID:	BD/EKOM/840/19 07025
Plant:	Ekofisk M	Rev No.:	01
System:	EOT SWL 15T TAG: 07025	Date:	08.04.2018
Subsystem:			
Analyst:	Øystein Refsland Andreassen		

Type	Bounding system	Interface location	Ref. drawing
IN (690V)	Instrument	28-00002-05D	E900-11915-E-00077
IN (Structural)	Runway	W30	E900-11915-M-0038
OUT (Energy)	Hoist	W30	E900-11915-M-0038

3-4 System Work Breakdown Structure

No #	TAG No.	Description	System	Sub-system	Type (Instrument only)	Qty	Dwg or ref
1	19 07025	CRANE OVERHEAD TRAVELLING 15 T	All	-		1	E900-11915-M-00038
2		BUMPER	Bridge	Bumper		4	E900-11915-M-00038
3		CABLE LOOP	Bridge	Cable tray		1	E900-11915-M-00038
4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	Bridge	Crane drive		1	E900-11915-M-00038
5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	Bridge	Crane drive		1	E900-11915-M-00038
6		GEARBOX. MOTOR TRAVELLING	Bridge	Crane drive		1	E900-11915-M-00038
7		GEARBOX. MOTOR TRAVELLING	Bridge	Crane drive		1	E900-11915-M-00038
8		DRIVE PINION	Bridge	Crane drive		2	E900-11915-M-00038
9		TRAVEL WHEELS	Bridge	Travel wheels		16	E900-11915-M-00038
10		TROLLEY GEAR RACK	Bridge	Trolley gear rack		1	E900-11915-M-00038
11	30 07025	MOTOR HOIST. CRANE OVERHEAD	Hoist	Hoist drive		1	E900-11915-M-00038
12		GEARBOX MOTOR HOIST	Hoist	Hoist drive		1	E900-11915-M-00038
13		DRUM BEARINGS	Hoist	Hoist drive		2	E900-11915-M-00038
14	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	Hoist	Lower block		1	E900-11915-M-00038
15		UPPER BLOCK	Hoist	Upper block		1	E900-11915-M-00038
16	19 02820	WIRE 14 MM MIN BRUDD 20T	Hoist	Wire rope		1	E900-11915-M-00038
17		WIRE END CONNECTION OUTER	Hoist	Wire rope		1	E900-11915-M-00038
18		WIRE END CONNECTION	Hoist	Wire rope clamp		1	E900-11915-M-00038
19	28 JE-07025	BOX JUNCTION OVERHEAD CRANE 19 07025	Instrument	Junction box		1	E900-11915-E-00077
20	28 JE-07026	BOX JUNCTION OVERHEAD CRANE 19 07025	Instrument	Junction box		1	E900-11915-E-00077
21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00077
22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	Instrument	Limit switch bridge	Protection	1	E900-11915-E-00077
23	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	Instrument	Limit switch hoist	Protection	1	E900-11915-E-00077
24	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	Instrument	Limit switch hoist	Protection	1	E900-11915-E-00077
25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00077
26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	Instrument	Limit switch trolley	Protection	1	E900-11915-E-00077
27		OVERLOAD SWITCH HOIST	Instrument	Overload switch hoist	Protection	1	E900-11915-E-00077
28	28 07025	SWITCH MAIN FOR OVERHEAD CRANE 19 07025	Instrument	Pennant	Control	1	E900-11915-E-00077
29	28 07026	SWITCH PUSH BUTTON STATION FOR 19 07025	Instrument	Pennant	Control	1	E900-11915-E-00077
30	28 08296	SWITCH EMERG STOP CRANE 19 07026	Instrument	Pennant	Control	1	
31	28 LCP-07025	PANEL CONTROL OVERHEAD CRANE 19 07025	Instrument	Radio remote	Control	1	
32	19 07560	PADEYE TEST SWL 25T (FOR OT CRANE)	Other	-		1	
33		BRIDGE GEAR RACK	Runway	Runway beams		2	E900-11915-M-00038
34		RUNWAY BEAMS	Runway	Runway beams		2	E900-11915-M-00038
35		TROLLEY TRAVEL WHEELS	Trolley	Travelling wheels		4	E900-11915-M-00038
36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	Trolley	Trolley drive		1	E900-11915-M-00038
37		GEARBOX TROLLEY MOTOR	Trolley	Trolley drive		1	E900-11915-M-00038
38		PINION TROLLEY DRIVE	Trolley	Trolley drive		1	E900-11915-M-00038

3-5 Equipment history

Date	TAG No.	Description	System	Sub-system	Failure mode	Failure Cause
27.12.2008		Control cabinet	Instrument	Other	Unknown	Unknown
21.01.2009		Brake	Hoist	Brake	Damaged	Unknown
01.03.2009		Brake	Hoist	Brake	Damaged	Unknown
09.03.2009		Wire rope	Hoist	Wire rope	Lubrication missing	Unknown - Environment?
09.03.2009		Wire pendant	Instrument	Pendant	Damaged	Unknown
25.02.2010		Electrical protection device	Instrument	Electrical protection devices	Insufficient	Electrical motor protection device used on two motors.
13.03.2010		Pendant	Instrument	Pendant	Water penetration	Seals damaged
13.03.2010		Wire pendant	Instrument	Pendant	Damaged	Unknown
13.03.2010		Brake	Hoist	Brake	Not tested	Not possible to connect to padeye
28.06.2010		Overload switch hoist	Instrument	Overload switch	Unstable	Unknown
14.03.2011		Marking	Instrument	Pendant	Missing	Unkown
19.03.2012		Marking	Instrument	Pendant	Missing	Unnkown
09.03.2013		Emergency stop	Instrument	Pendant	Damaged	Unknown
09.03.2013		Wire pendant	Instrument	Pendant	Damaged	Unknown
15.03.2014		Wire rope	Hoist	Wire rope	Damaged	Unknown
09.09.2014	BD/EKOM/19 02819	Lower block	Hoist	Lower block	Worn	Unknown - Environment?
09.09.2014		Wire end connection	Hoist	Wire rope clamp	Damaged	Unknown
06.03.2016		Overload switch hoist	Instrument	Overload switch	Slow	Unknown
02.11.2016		Control cabinet	Instrument	Other	Unknown	Unknown
04.03.2017	BD/EKOM/19 02820	Wire rope	Hoist	Wire rope	Wrong	Unknown
04.03.2017	BD/EKOM/28 08296	Emergency stop	Instrument	Pendant	Wrong	Unknown
04.03.2017		Trolley boogie	Trolley	Trolley drive	Corroded	Unknown

4 Functional failure

Function #	FF #	Function/Functional failure
2		Dampen and mitigate collision if needed
	2.1	No damping of bridge
3		Hold the cables when the trolley is moving
	3.1	Cables fall of
	3.2	Cable loop snags in other structure
4		Transmit rotational forces through gearbox and drive pinion in order to move bridge
	4.1	Bridge stationary
5		Transmit rotational forces through gearbox and drive pinion in order to move bridge
	5.1	Bridge stationary
6		Transmit rotational forces from motor to drive pinion in order to move bridge
	6.1	Bridge stationary
7		Transmit rotational forces from motor to drive pinion in order to move bridge
	7.1	Bridge stationary
8		Transmit rotational forces from gearbox to gear rack in order to move bridge
	8.1	Bridge stationary
9		Support bridge on runway and enable smooth movement of bridge
	9.1	Load falling
	9.2	Bridge stationary
10		Enable smooth movement of the trolley
	10.1	Trolley stationary
11		Move load up and down, and hold load when stopped
	11.1	Hook stationary
	11.2	Load falling
12		Transmit rotational forces from motor to drum
	12.1	Hook stationary
	12.2	Load falling
13		Enable smooth rotation of drum and support drum
	13.1	Hook stationary
14		Move load up and down
	14.1	Hook stationary
	14.2	Load falling
15		Guide wire rope
	15.1	Hook stationary
	15.2	Load falling
16		Move the hook up and down

	16.1	Hook stationary
	16.2	Load falling
17		Hold the "dead" end of the wire rope
	17.1	Hook stationary
	17.2	Load falling
18		Hold the dead end of the wire rope on the drum
	18.1	Load falling
19		Hold the main electrical connections to the crane
	19.1	Crane without power
20		Hold the main electrical connections to the crane (secondary box)
	20.1	Crane without power
21		Limit crane bridge travel west
	21.1	Bridge stationary
	21.2	Bridge colliding
22		Limit crane bridge travel east
	22.1	Bridge stationary
	22.2	Bridge colliding
23		Limit hook traveling into the drum
	23.1	Hook stationary
	23.2	Hook pulled into the winch drum
24		Limit hook from touching the floor, slack wire
	24.1	Hook stationary
	24.2	Hook touching the floor, wire slack
25		Limit trolley travel north
	25.1	Trolley stationary
	25.2	Trolley colliding
26		Limit trolley travel south
	26.1	Trolley stationary
	26.2	Trolley colliding
27		Prevent the hoist from overloading the crane
	27.1	Hook stationary
	27.2	Crane overloaded
28		Hold the main power to the crane
	28.1	Crane without power
	28.2	Power will not turn off
29		Update the crane functions when radio control is disconnected (emergency operation)

	29.1	Bridge stationary
	29.2	Trolley stationary
	29.3	Hook stationary
	29.4	Crane stuck in high speed
	29.5	Crane stuck in low speed
	29.6	Crane will not stop
	29.7	Crane will not reset (All functions stationary)
30		Emergency stop all crane functions
	30.1	Crane not working
	30.2	Crane not stopping
31		Operate crane functions
	31.1	Bridge stationary
	31.2	Trolley stationary
	31.3	Hook stationary
	31.4	Crane will not stop
	31.5	Crane will not reset (All functions stationary)
32		Point of attaching crane for load testing. Holding load.
	32.1	Pulling out the load test point when applying load (Not holding the test load)
33		Enable smooth movement of the bridge
	33.1	Bridge stationary
34		Support the bridge
	34.1	Bridge falls down - Load falling
35		Support the trolley on the bridge and enable smooth movement
	35.1	Trolley stationary
	35.2	Trolley falls down - Load falling
36		Transmit rotational forces through gearbox and drive pinion in order to move trolley
	36.1	Trolley stationary
37		Transmit rotational forces from motor to pinion in order to move trolley
	37.1	Trolley stationary
38		Transmit rotational forces from gearbox to gir rack in order to move trolley
	38.1	Trolley stationary

5-1 Equipment-functional failure matrix

No.	TAG No.	Component description	Functional failures	2.1 No damping of bridge	3.1 Cables fall off	3.2 Cable loop snags in structure	4.1 Bridge stationary	9.1 Load falling	10.1 Trolley stationary	11.1 Hook stationary	19.1 Crane without power / Will not reset
2		BUMPER		X							
3		CABLE LOOP			3.2	X					
4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.					X				
5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.					X				
6		GEARBOX. MOTOR TRAVELLING					X				
7		GEARBOX. MOTOR TRAVELLING					X				
8		DRIVE PINION					X				
9		TRAVEL WHEELS					X	X			
10		TROLLEY GEAR RACK							X		
11	30 07025	MOTOR HOIST. CRANE OVERHEAD						X		X	
12		GEARBOX MOTOR HOIST						11.1		X	
13		DRUM BEARINGS								X	
14	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK						X		X	
15		UPPER BLOCK						X		X	
16	19 02820	WIRE 14 MM MIN BRUDD 20T						11.1		X	
17		WIRE END CONNECTION OUTER						11.1		X	
18		WIRE END CONNECTION						X			
19	28 JE-07025	BOX JUNCTION OVERHEAD CRANE 19 07025					11.1		11.1	X	11.1
20	28 JE-07026	BOX JUNCTION OVERHEAD CRANE 19 07025					11.1		11.1	X	11.1
21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025					X				
22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025					X				
23	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025								X	
24	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19								X	
25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025							X		
26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025							X		
27		OVERLOAD SWITCH HOIST								X	
28	28 07025	SWITCH MAIN FOR OVERHEAD CRANE 19 07025					11.1		11.1	X	11.1
29	28 07026	SWITCH PUSH BUTTON STATION FOR 19 07025					11.1		11.1	X	11.1
30	28 08296	SWITCH EMERG STOP CRANE 19 07025					11.1		11.1	X	11.1
31	28 LCP-07025	PANEL CONTROL OVERHEAD CRANE 19 07025					11.1		11.1	X	11.1
32	19 07560	PADEYE TEST SWL 25T (FOR OT CRANE)									
33		BRIDGE GEAR RACK					X				
34		RUNWAY BEAMS						X			
35		TROLLEY TRAVEL WHEELS						X	X		
36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025							X		
37		GEARBOX TROLLEY MOTOR							X		
38		PINION TROLLEY DRIVE							X		

5-2 FMEA

FF#	COMP	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Local	System	Plant	LTA
2.1	2		BUMPER	2.1	Brittle	2.1.1	Age	Broken bumpers	Limited damping of bridge if collision	None imidiate	No
3.2	3		CABLE LOOP	3.1	Broken	3.1.1	Snagging in structures	Cables could be broken	No connection with motors or instruments	Material handling not possible	Yes
4.1	4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	4.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	4.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	4.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	5.1.1	Insufficient lubrication	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	5.2.1	Age	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	5.3.1	Worn brake	No movement in motor	Bridge travel restricted	Material handling not possible	Yes
4.1	6		GEARBOX. MOTOR TRAVELLING	6.1	Gearbox not rotating	6.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
4.1	7		GEARBOX. MOTOR TRAVELLING	7.1	Gearbox not rotating	7.1.1	Broken gears	No movement in output axle	Bridge travel restricted	Material handling not possible	Yes
4.1	8		DRIVE PINION	8.1	Drive pinion not rotating	8.1.1	Broken theets	No movent on rack drive	Bridge travel restricted	Material handling not possible	Yes
4.1	9		TRAVEL WHEELS	9.1	Deformed	9.1.1	Bearing failure	Limited movement	Bridge travel restricted	Material handling not possible	Yes
4.1	21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	21.1.1	Age	Limit switch activated	Bridge travel restricted west direction	Moving the crane south is not possible	Yes
4.1	21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	21.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted west direction	Moving the crane south is not possible	Yes
4.1	21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.2	Broken	21.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted west direction	Moving the crane south is not possible	Yes
4.1	22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	22.1.1	Age	Limit switch activated	Bridge travel restricted east direction	Moving the crane north is not possible	Yes
4.1	22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	22.1.2	Dirt activating the switch	Limit switch activated	Bridge travel restricted east direction	Moving the crane north is not possible	Yes
4.1	22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.2	Broken	22.2.1	Moisture in the electronics	Limit switch activated	Bridge travel restricted east direction	Moving the crane north is not possible	Yes
4.1	33		BRIDGE GEAR RACK	33.1	Broken	33.1.1	Missing rack theets	No contact between pinion and rack	Bridge travel restricted	Material handling not possible	Yes
9.1	9		TRAVEL WHEELS	9.2	Structural failure	9.2.1	Massive degredation to structure	Overload of existing structure.	Bridge collapse	Crane collapse	Yes
9.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	11.4.1	Wear and tear	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	14	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	14.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	15		UPPER BLOCK	15.2	Severe structural corrosion	15.2.1	Lack of sufficient cross section in axle	Not holding load	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	18		WIRE END CONNECTION	18.1	Severe structural corrosion	18.1.1	Lack of sufficient cross section	Not holding load if the wire is run of the drum	Hook travelling uncontrolled down	Material handling not possible	Yes
9.1	34		RUNWAY BEAMS	34.1	Severe structural corrosion	34.1.1	Lack of sufficient cross section in structural supports	Not holding load	Crane runway falling down	Crane collapse	Yes
9.1	35		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	35.1.1	Lack of sufficient cross section in axle	Not holding load	Trolley boogie falling down	Trolley collapse	Yes
10.1	10		TROLLEY GEAR RACK	10.1	Broken	10.1.1	Missing rack theets	No contact between pinion and rack	Trolley travel restricted	Material handling not possible	Yes
10.1	25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	25.1.1	Age	Not possible to move the trolley in north direction	Trolley travel restricted north	Material handling limited	Yes
10.1	25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	25.1.2	Dirt activating the switch	Not possible to move the trolley in north direction	Trolley travel restricted north	Material handling limited	Yes
10.1	25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.2	Broken	25.2.1	Moisture in the electronics	Not possible to move the trolley in north direction	Trolley travel restricted north	Material handling limited	Yes
10.1	26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	26.1.1	Age	Not possible to move the trolley in south direction	Trolley travel restricted south	Material handling limited	Yes
10.1	26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	26.1.2	Dirt activating the switch	Not possible to move the trolley in south direction	Trolley travel restricted south	Material handling limited	Yes
10.1	26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.2	Broken	26.2.1	Moisture in the electronics	Not possible to move the trolley in south direction	Trolley travel restricted south	Material handling limited	Yes

10.1	35		TROLLEY TRAVEL WHEELS	35.1	Deformed	35.1.1	Bearing failure	Limited movement	Trolley travel restricted	Material handling not possible	Yes
10.1	36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.1	Motor bearing defective	36.1.1	Insufficient lubrication	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
10.1	36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.2	Motor cage or rotor defective	36.2.1	Age	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
10.1	36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.3	Brake not releasing	36.3.1	Worn brake	No movement in motor	Trolley travel restricted	Material handling not possible	Yes
10.1	37		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	37.1.1	Broken gears	No movement in output axle	Trolley travel restricted	Material handling not possible	Yes
10.1	38		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	38.1.1	Broken theets	No movent on rack drive	Trolley travel restricted	Material handling not possible	Yes
11.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	11.1.1	Insufficient lubrication	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
11.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	11.2.1	Age	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
11.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	11.3.1	Worn brake	No movement in motor	Hoist movement restricted	Material handling not possible	Yes
11.1	12		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	12.1.1	Broken gears	No movement in output axle	Hoist movement restricted	Material handling not possible	Yes
11.1	13		DRUM BEARINGS	13.1	Bearing failure	13.01.2001	Insufficient lubrication	Bearing failure	Hoist movement restricted	Material handling not possible	Yes
11.1	14	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	14.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
11.1	15		UPPER BLOCK	15.1	Corrosion in bearings	15.1.1	Water penetration in bearings.	No movement in sheave wheels	Hook movement restricted	Material handling not possible	Yes
11.1	16	19 02820	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	16.1.1	Broken because of severe missuse or deterioration	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
11.1	16	19 02820	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	16.2.1	Lack of lubrication	No wire to lift the hook	Hook movement restricted	Material handling not possible	Yes
11.1	17		WIRE END CONNECTION OUTER	17.1	Broken	17.1.1	Broken because of severe missuse or deterioration	No end connection able to hold the load.	Hook movement restricted	Material handling not possible	Yes
11.1	19	28 JE-07025	BOX JUNCTION OVERHEAD CRANE 19 07025	19.1	Shorted	19.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
11.1	20	28 JE-07026	BOX JUNCTION OVERHEAD CRANE 19 07025	20.1	Shorted	20.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
11.1	23	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	23.1	False indication	23.1.1	Age	Limit switch activated	Could give restictions for how high a load can be lifted	None imidiate	Yes
11.1	23	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	23.2	Incorrect setting	23.2.1	Unkown	Limit switch activated	Could give restictions for how high a load can be lifted	None imidiate	Yes
11.1	24	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	23.1	False indication	23.1.1	Age	Limit switch activated	Could give restictions for how low the hook can be louvered	None imidiate	Yes
11.1	24	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	23.2	Incorrect setting	23.2.1	Unkown	Limit switch activated	Could give restictions for how low the hook can be louvered	None imidiate	Yes
11.1	27		OVERLOAD SWITCH HOIST	27.1	False indication	27.1.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
11.1	27		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	27.2.1	Moisture in the electronics	Overload switch activated	Hook movement restricted	Material handling not possible	Yes
11.1	28	28 07025	SWITCH MAIN FOR OVERHEAD CRANE 19 07025	28.1	Shorted	28.1.1	Shorted because of moisture	No power to crane	No power to crane	Material handling not possible	Yes
11.1	29	28 07026	SWITCH PUSH BUTTON STATION FOR 19 07025	29.1	Shorted	29.1.1	Shorted because of moisture	Hoist control function not working	Hoisting restricted	Material handling not possible	Yes
11.1	30	28 08296	SWITCH EMERG STOP CRANE 19 07025	30.1	Shorted	30.1.1	Shorted because of moisture	Not possible to start the crane	Not possible to start the crane	Material handling not possible	Yes

6 LTA

FF#	COMP	TAG	Component Description	FM#	Failure Mode	Evident?	Safety	Outage	Cat	Comment
3.2	3		CABLE LOOP	3.1	Broken	Yes	No	Yes	B	Could stop the whole crane
4.1	4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	Yes	No	Yes	B	
4.1	4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	Yes	No	Yes	B	
4.1	4	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	Yes	No	Yes	B	
4.1	5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	Yes	No	Yes	B	
4.1	5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	Yes	No	Yes	B	
4.1	5	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	Yes	No	Yes	B	
4.1	6		GEARBOX. MOTOR TRAVELLING	6.1	Gearbox not rotating	Yes	No	Yes	B	
4.1	7		GEARBOX. MOTOR TRAVELLING	7.1	Gearbox not rotating	Yes	No	Yes	B	
4.1	8		DRIVE PINION	8.1	Drive pinion not rotating	Yes	No	Yes	B	
4.1	9		TRAVEL WHEELS	9.1	Deformed	Yes	No	Yes	B	
4.1	21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	Yes	Yes		A	
4.1	21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	Yes	Yes		A	
4.1	21	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.2	Broken	Yes	Yes		A	
4.1	22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	Yes	Yes		A	
4.1	22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	Yes	Yes		A	
4.1	22	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.2	Broken	Yes	Yes		A	
4.1	33		BRIDGE GEAR RACK	33.1	Broken	Yes	No	Yes	B	
9.1	9		TRAVEL WHEELS	9.2	Structural failure	Yes	Yes		A	
9.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	Yes	Yes		A	
9.1	14	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	Yes	Yes		A	
9.1	15		UPPER BLOCK	15.2	Severe structural corrosion	Yes	Yes		A	
9.1	18		WIRE END CONNECTION	18.1	Severe structural corrosion	Yes	Yes		A	
9.1	34		RUNWAY BEAMS	34.1	Severe structural corrosion	Yes	Yes		A	
9.1	35		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	Yes	Yes		A	
10.1	10		TROLLEY GEAR RACK	10.1	Broken	Yes	No		B	
10.1	25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	Yes	Yes		A	
10.1	25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	Yes	Yes		A	
10.1	25	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.2	Broken	Yes	Yes		A	
10.1	26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	Yes	Yes		A	
10.1	26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	Yes	Yes		A	
10.1	26	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.2	Broken	Yes	Yes		A	
10.1	35		TROLLEY TRAVEL WHEELS	35.1	Deformed	Yes	Yes		A	

10.1	36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.1	Motor bearing defective	Yes	No	Yes	B	
10.1	36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.2	Motor cage or rotor defective	Yes	No	Yes	B	
10.1	36	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.3	Brake not releasing	Yes	No	Yes	B	
10.1	37		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	Yes	No	Yes	B	
10.1	38		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	Yes	No	Yes	B	
11.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	Yes	Yes		A	
11.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	Yes	Yes		A	
11.1	11	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	Yes	Yes		A	
11.1	12		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	Yes	Yes		A	
11.1	13		DRUM BEARINGS	13.1	Bearing failure	Yes	No	Yes	B	
11.1	14	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	Yes	Yes		A	
11.1	15		UPPER BLOCK	15.1	Corrosion in bearings	Yes	Yes		A	
11.1	16	19 02820	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	Yes	Yes		A	
11.1	16	19 02820	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	Yes	Yes		A	
11.1	17		WIRE END CONNECTION OUTER	17.1	Broken	Yes	Yes		A	
11.1	19	28 JE-07025	BOX JUNCTION OVERHEAD CRANE 19 07025	19.1	Shorted	Yes	No	Yes	B	
11.1	20	28 JE-07026	BOX JUNCTION OVERHEAD CRANE 19 07025	20.1	Shorted	Yes	No	Yes	B	
11.1	23	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	23.1	False indication	Yes	Yes		A	
11.1	23	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	23.2	Incorrect setting	Yes	Yes		A	
11.1	24	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	23.1	False indication	Yes	Yes		A	
11.1	24	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	23.2	Incorrect setting	Yes	Yes		A	
11.1	27		OVERLOAD SWITCH HOIST	27.1	False indication	Yes	Yes		A	
11.1	27		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	Yes	Yes		A	
11.1	28	28 07025	SWITCH MAIN FOR OVERHEAD CRANE 19 07025	28.1	Shorted	Yes	No	Yes	B	
11.1	29	28 07026	SWITCH PUSH BUTTON STATION FOR 19 07025	29.1	Shorted	Yes	No	Yes	B	
11.1	30	28 08296	SWITCH EMERG STOP CRANE 19 07025	30.1	Shorted	Yes	Yes		A	
11.1	31	LCP-07025	PANEL CONTROL OVERHEAD CRANE 19 07025	31.1	Shorted	Yes	Yes		A	
32.1	32	19 07560	PADEYE TEST SWL 25T (FOR OT CRANE)	32.1	Overstress	Yes	Yes		A	

7-1 Task selection

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	FC#	Failure Cause	Cat	1	2	3	4	5	6	7	Candidate Task	Effective Info	Selective dec.	Est Freq.
9.1	9	Bridge		TRAVEL WHEELS	9.2	Structural failure	9.2.1	Massive degradation to structure	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
3.2	3	Bridge		CABLE LOOP	3.1	Broken	3.1.1	Snagging in structures	B	P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation - TD	1Y
4.1	4	Bridge	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	4.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun - TD	4Y
4.1	4	Bridge	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	4.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
4.1	4	Bridge	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	4.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
4.1	5	Bridge	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	5.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
4.1	5	Bridge	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	5.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
4.1	5	Bridge	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	5.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
4.1	6	Bridge		GEARBOX, MOTOR TRAVELLING	6.1	Gearbox not rotating	6.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
4.1	7	Bridge		GEARBOX, MOTOR TRAVELLING	7.1	Gearbox not rotating	7.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
4.1	8	Bridge		DRIVE PINION	8.1	Drive pinion not rotating	8.1.1	Broken theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
4.1	9	Bridge		TRAVEL WHEELS	9.1	Deformed	9.1.1	Bearing failure	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	10	Bridge		TROLLEY GEAR RACK	10.1	Broken	10.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
9.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	11.4.1	Wear and tear	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	11.1.1	Insufficient lubrication	A	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
11.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	11.2.1	Age	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
11.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	11.3.1	Worn brake	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	12	Hoist		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	12.1.1	Broken gears	A	P	Y	N	N	-	Y	-	1. Verify oil level - TD 2. Change oil - TD		1. Verify oil level - TD 2. Change oil - TD	1, 1Y 2, 4Y
9.1	14	Hoist	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	14.2.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	14	Hoist	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	14.1.1	Water penetration in bearings.	A	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M
9.1	15	Hoist		UPPER BLOCK	15.2	Severe structural corrosion	15.2.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	15	Hoist		UPPER BLOCK	15.1	Corrosion in bearings	15.1.1	Water penetration in bearings.	A	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	3M

11.1	16	Hoist	19 02820	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	16.1.1	Broken because of severe missuse or deterioration	A		Y	Y	N	N	-	Y	-	1. Inspect wire rope 2. Change wire rope		1. Inspect wire rope 2. Change wire rope	1. 1M 2. 1Y
11.1	16	Hoist	19 02820	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	16.2.1	Lack of lubrication	A		P	Y	N	N	-	Y	-	1. Inspect wire rope 2. Lubricate wire rope		1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M
11.1	17	Hoist		WIRE END CONNECTION OUTER	17.1	Broken	17.1.1	Broken because of severe missuse or deterioration	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
9.1	18	Hoist		WIRE END CONNECTION	18.1	Severe structural corrosion	18.1.1	Lack of sufficient cross section	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
11.1	13	Hoist		DRUM BEARINGS	13.1	Bearing failure	13.01.2001	Insufficient lubrication	B		P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun - TD	1Y
4.1	21	Instrument	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	21.1.1	Age	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	21	Instrument	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	21.1.2	Dirt activating the switch	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	21	Instrument	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.2	Broken	21.2.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Effectively OEM is referring to IEC 60079-17, which in terms are giving instructions to inspect at least every 3Y. 1Y is based on analysts personal experience of the build-up of moisture in JB offshore.	1. Inspect and clean - TD	1Y
4.1	22	Instrument	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	22.1.1	Age	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	22	Instrument	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	22.1.2	Dirt activating the switch	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
4.1	22	Instrument	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.2	Broken	22.2.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	23	Instrument	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	23.1	False indication	23.1.1	Age	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	23	Instrument	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	23.2	Incorrect setting	23.2.1	Unkown	A		P	Y	N	N	-	Y	-	1. Verify limits		1. Verify limits	3M
11.1	24	Instrument	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	23.1	False indication	23.1.1	Age	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	24	Instrument	ZS-01869	SW LIMIT POS HOOK BOTT OVERH CRANE 19 07025	23.2	Incorrect setting	23.2.1	Unkown	A		P	Y	N	N	-	Y	-	1. Verify limits		1. Verify limits	3M
10.1	25	Instrument	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	25.1.1	Age	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	25	Instrument	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	25.1.2	Dirt activating the switch	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	25	Instrument	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.2	Broken	25.2.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	26	Instrument	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	26.1.1	Age	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	26	Instrument	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	26.1.2	Dirt activating the switch	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
10.1	26	Instrument	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	26.2	Broken	26.2.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.1	False indication	27.1.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	27.2.1	Moisture in the electronics	A		P	Y	N	N	-	Y	-	1. Verify limits		1. Verify limits	3M
11.1	30	Instrument	28 08296	SWITCH EMERG STOP CRANE 19 07025	30.1	Shorted	30.1.1	Shorted because of moisture	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	31	Instrument	LCP-07025	PANEL CONTROL OVERHEAD CRANE 19 07025	31.1	Shorted	31.1.1	Shorted because of moisture	A		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	19	Instrument	28 JE-07025	BOX JUNCTION OVERHEAD CRANE 19 07025	19.1	Shorted	19.1.1	Shorted because of moisture	B		P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y

11.1	20	Instrument	28 JE-07026	BOX JUNCTION OVERHEAD CRANE 19 07025	20.1	Shorted	20.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	28	Instrument	28 07025	SWITCH MAIN FOR OVERHEAD CRANE 19 07025	28.1	Shorted	28.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
11.1	29	Instrument	28 07026	SWITCH PUSH BUTTON STATION FOR 19 07025	29.1	Shorted	29.1.1	Shorted because of moisture	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	See FM 21.2	1. Inspect and clean - TD	1Y
32.1	32	Other	19 07560	PADEYE TEST SWL 25T (FOR OT CRANE)	32.1	Overstress	32.1.1	Tear out due to loss of cross section	A	P	Y	N	N	-	Y	-	1. Check for wear and tear or deformation - TD	Part of annual control.	1. Check for wear and tear or deformation TD	1Y
9.1	34	Runway		RUNWAY BEAMS	34.1	Severe structural corrosion	34.1.1	Lack of sufficient cross section in structural supports	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
4.1	33	Runway		BRIDGE GEAR RACK	33.1	Broken	33.1.1	Missing rack theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y
9.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	35.1.1	Lack of sufficient cross section in axle	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Deformed	35.1.1	Bearing failure	A	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	36	Trolley	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.1	Motor bearing defective	36.1.1	Insufficient lubrication	B	P	Y	N	N	-	Y	-	1. Lubricate with grease gun - TD		1. Lubricate with grease gun. - TD	4Y
10.1	36	Trolley	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.2	Motor cage or rotor defective	36.2.1	Age	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	IEC60079-17 gives largest interval of 3Y for check of flameproof motors	1. Inspect and clean - TD	3Y
10.1	36	Trolley	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.3	Brake not releasing	36.3.1	Worn brake	B	P	Y	N	N	-	Y	-	1. Inspect and clean - TD	Part of annual control.	1. Inspect and clean - TD	1Y
10.1	37	Trolley		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	37.1.1	Broken gears	B	P	Y	N	N	-	Y	-	1. Change oil - TD		1. Change oil - TD	4Y
10.1	38	Trolley		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	38.1.1	Broken theets	B	P	Y	N	N	-	Y	-	1. Lubricate with burshed or sprayed on grease - TD		1. Lubricate with burshed or sprayed on grease - TD	1Y

7-2 Sanity check

FF#	Comp #	TAG	Component Description	FM#	Failure mode	1	2	3	4	5	6	7	8	RTF	Selection Dec	Est Freq	Comments
2.1	2		BUMPER	2.1	Brittle	N	N	N	N	N	N	N	N	RTF	RTF		

7-3 Task comparison

FF#	COMP	System	TAG	Component Description	FM#	Failure Mode	Selective dec.	Est Freq.	Current Task	Freq.
2.1	2	Bridge		Bumper	2.1	Brittle	RTF			
3.2	3	Bridge		CABLE LOOP	3.1	Broken	1. Check for wear and tear or deformation - TD	1Y	WS-19OVER30. M	6M
4.1	4	Bridge	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
4.1	4	Bridge	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
4.1	4	Bridge	30 07027	MOTOR TRAVEL CRANE OVERHEAD.	4.3	Brake not releasing	1. Inspect and clean - TD	1Y		
4.1	5	Bridge	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
4.1	5	Bridge	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y
4.1	5	Bridge	30 07028	MOTOR TRAVEL CRANE OVERHEAD.	5.3	Brake not releasing	1. Inspect and clean - TD	1Y		
4.1	6	Bridge		GEARBOX. MOTOR TRAVELLING	6.1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER46. M	4Y
4.1	7	Bridge		GEARBOX. MOTOR TRAVELLING	7.1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER46. M	4Y
4.1	8	Bridge		DRIVE PINION	8.1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER46. M	1Y
9.1	9	Bridge		TRAVEL WHEELS	9.2	Structural failure	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	9	Bridge		TRAVEL WHEELS	9.1	Deformed	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	10	Bridge		TROLLEY GEAR RACK	10.1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER46. M	1Y
9.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.4	Brake not engaging	1. Inspect and clean - TD	1Y		
11.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
11.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68. E	1Y

11.1	11	Hoist	30 07025	MOTOR HOIST. CRANE OVERHEAD	11.3	Brake not releasing	1. Inspect and clean - TD	1Y	WS-19OVER33. M	6M
11.1	12	Hoist		GEARBOX MOTOR HOIST	12.1	Gearbox not rotating	1. Verify oil level - TD 2. Change oil - TD	1. 1Y 2. 4Y	WS-19OVER46. M	4Y
11.1	13	Hoist		DRUM BEARINGS	13.1	Bearing failure	1. Lubricate with grease gun. - TD	1Y		
9.1	14	Hoist	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.2	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	14	Hoist	19 02819	BLOCK DOUBLE SHEAVE WITH HOOK	14.1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M	WS-19OVER59. M	3M
9.1	15	Hoist		UPPER BLOCK	15.2	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	15	Hoist		UPPER BLOCK	15.1	Corrosion in bearings	1. Lubricate with grease gun. - TD	3M	WS-19OVER59. M	3M
11.1	16	Hoist	19 02820	WIRE 14 MM MIN BRUDD 20T	16.1	Broken	1. Inspect wire rope 2. Change wire rope	1. 1M 2. 1Y	WS-19OVER59. M	3M
11.1	16	Hoist	19 02820	WIRE 14 MM MIN BRUDD 20T	16.2	Corroded	1. Inspect wire rope 2. Lubricate wire rope	1. 1M 2. 3M	WS-19OVER59. M	3M
11.1	17	Hoist		WIRE END CONNECTION OUTER	17.1	Broken	1. Inspect and clean - TD	1Y	WS-19OVER59. M	3M
9.1	18	Hoist		WIRE END CONNECTION	18.1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	19	Instrument	28 JE-07025	BOX JUNCTION OVERHEAD CRANE 19 07025	19.1	Shorted	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	20	Instrument	28 JE-07026	BOX JUNCTION OVERHEAD CRANE 19 07025	20.1	Shorted	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	21	Instrument	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	21	Instrument	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	21	Instrument	ZS-01872	SWITCH POS TRAVEL OVERH CRANE 19 07025	21.2	Broken	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	22	Instrument	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M

4.1	22	Instrument	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
4.1	22	Instrument	ZS-01873	SWITCH POS TRAVEL OVERH CRANE 19 07025	22.2	Broken	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	23	Instrument	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	23.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	23	Instrument	ZS-01871	SWITCH POS TROLLY OVERH CRANE 19 07025	23.2	Incorrect setting	1. Verify limits	3M	WS-19OVER30. M	6M
11.1	24	Instrument	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	24.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	24	Instrument	ZS-01868	SW LIMIT POS HOOK TOP OVERH CRANE 19 07025	24.2	Incorrect setting	1. Verify limits	3M	WS-19OVER30. M	6M
10.1	25	Instrument	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	25.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	26	Instrument	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	26.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
10.1	26	Instrument	ZS-01870	SWITCH POS TROLLY OVERH CRANE 19 07025	26.2	Broken	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.1	False indication	1. Inspect and clean - TD	1Y	WS-19OVER33. M	6M
11.1	27	Instrument		OVERLOAD SWITCH HOIST	27.2	Incorrect setting	1. Verify limits	1Y	WS-19OVER33. M	6M
11.1	28	Instrument	28 07025	SWITCH MAIN FOR OVERHEAD CRANE 19 07025	28.1	Shorted	1. Inspect and clean - TD	1Y		
11.1	29	Instrument	28 07026	SWITCH PUSH BUTTON STATION FOR 19 07025	29.1	Shorted	1. Inspect and clean - TD	1Y		
11.1	30	Instrument	28 08296	SWITCH EMERG STOP CRANE 19 07025	30.1	Shorted	1. Inspect and clean - TD			
11.1	31	Instrument	LCP-07025	PANEL CONTROL OVERHEAD CRANE 19 07025	31.1	Shorted	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M
32.1	32	Other	19 07560	PADEYE TEST SWL 25T (FOR OT CRANE)	32.1	Overstress	1. Check for wear and tear or deformation - TD	1Y		
4.1	33	Runway		BRIDGE GEAR RACK	33.1	Broken	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER30. M	6M
9.1	34	Runway		RUNWAY BEAMS	34.1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30. M	6M

9.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Severe structural corrosion	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
10.1	35	Trolley		TROLLEY TRAVEL WHEELS	35.1	Deformed	1. Inspect and clean - TD	1Y	WS-19OVER30.M	6M
10.1	36	Trolley	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.1	Motor bearing defective	1. Lubricate with grease gun. - TD	4Y		
10.1	36	Trolley	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.2	Motor cage or rotor defective	1. Inspect and clean - TD	3Y	WS-30MOTO68.E	1Y
10.1	36	Trolley	30 07026	MOTOR TROLLEY. CRANE OVERHEAD 19 07025	36.3	Brake not releasing	1. Inspect and clean - TD	1Y		
10.1	37	Trolley		GEARBOX TROLLEY MOTOR	37.1	Gearbox not rotating	1. Change oil - TD	4Y	WS-19OVER46.M	4Y
10.1	38	Trolley		PINION TROLLEY DRIVE	38.1	Drive pinion not rotating	1. Lubricate with burshed or sprayed on grease - TD	1Y	WS-19OVER46.M	1Y