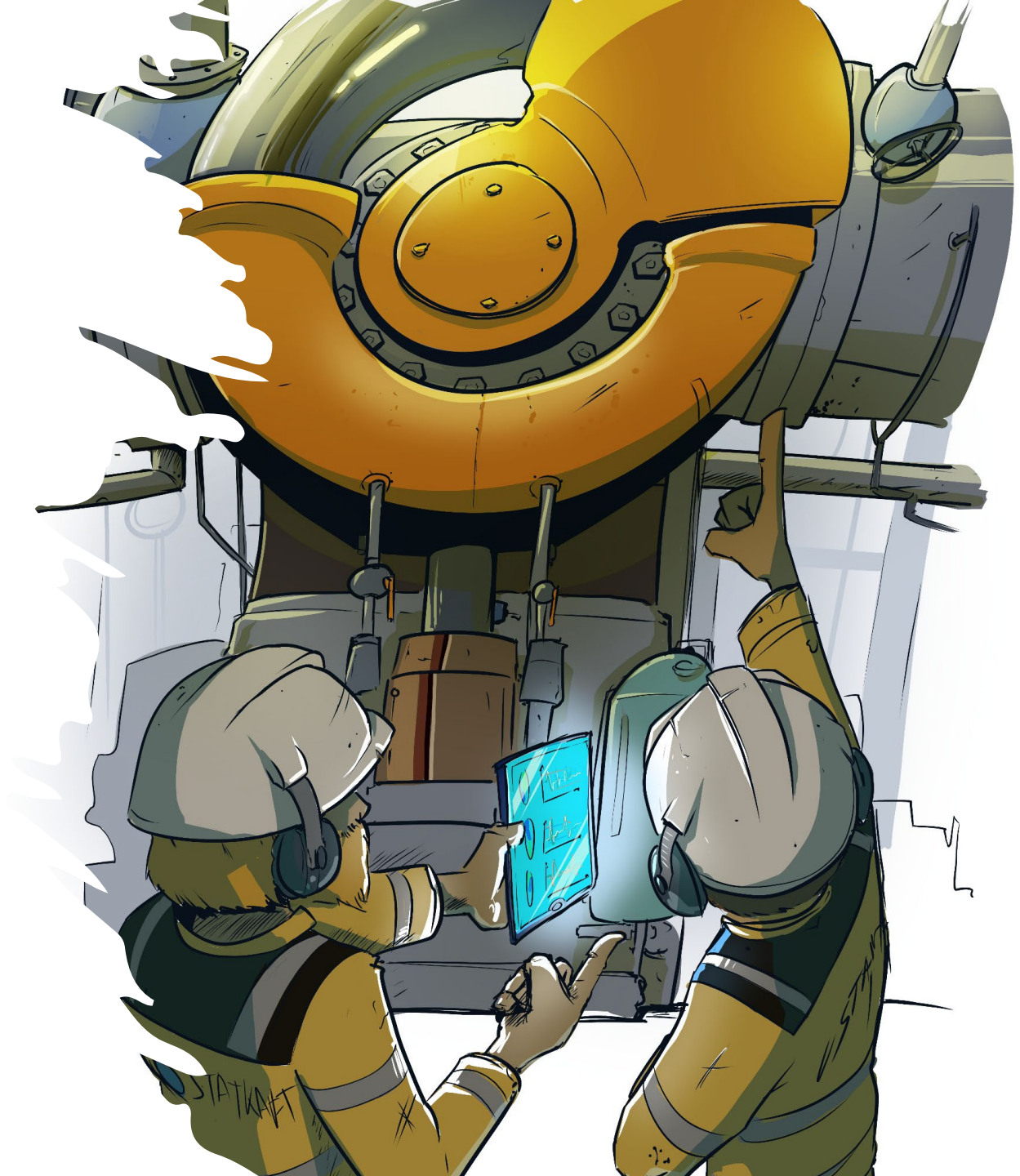
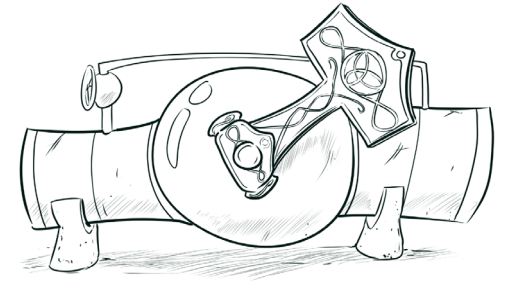


RCM 4 MIV

Reliability Centred Maintenance
on a Main Inlet Valve



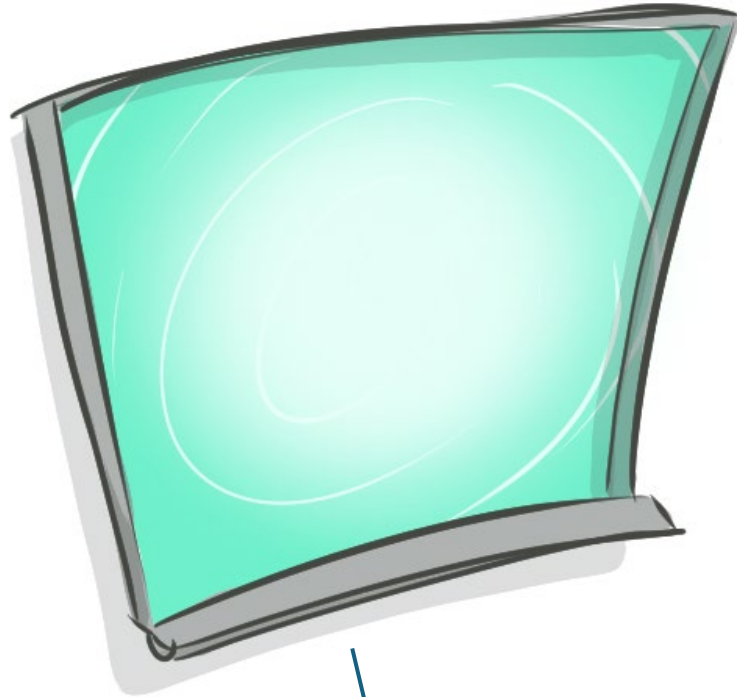


EBL-kodeplan
«Legacy»

VS

ISO/IEC 81346
«RDS»

Information presentation



Screen

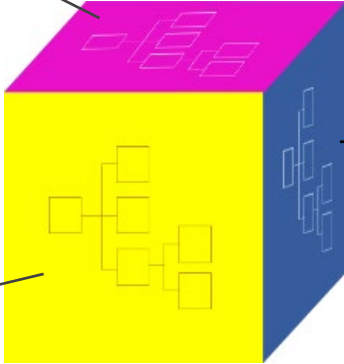
A note on RDS:
Aspects

+ Location
+Plant+2floor+zone4

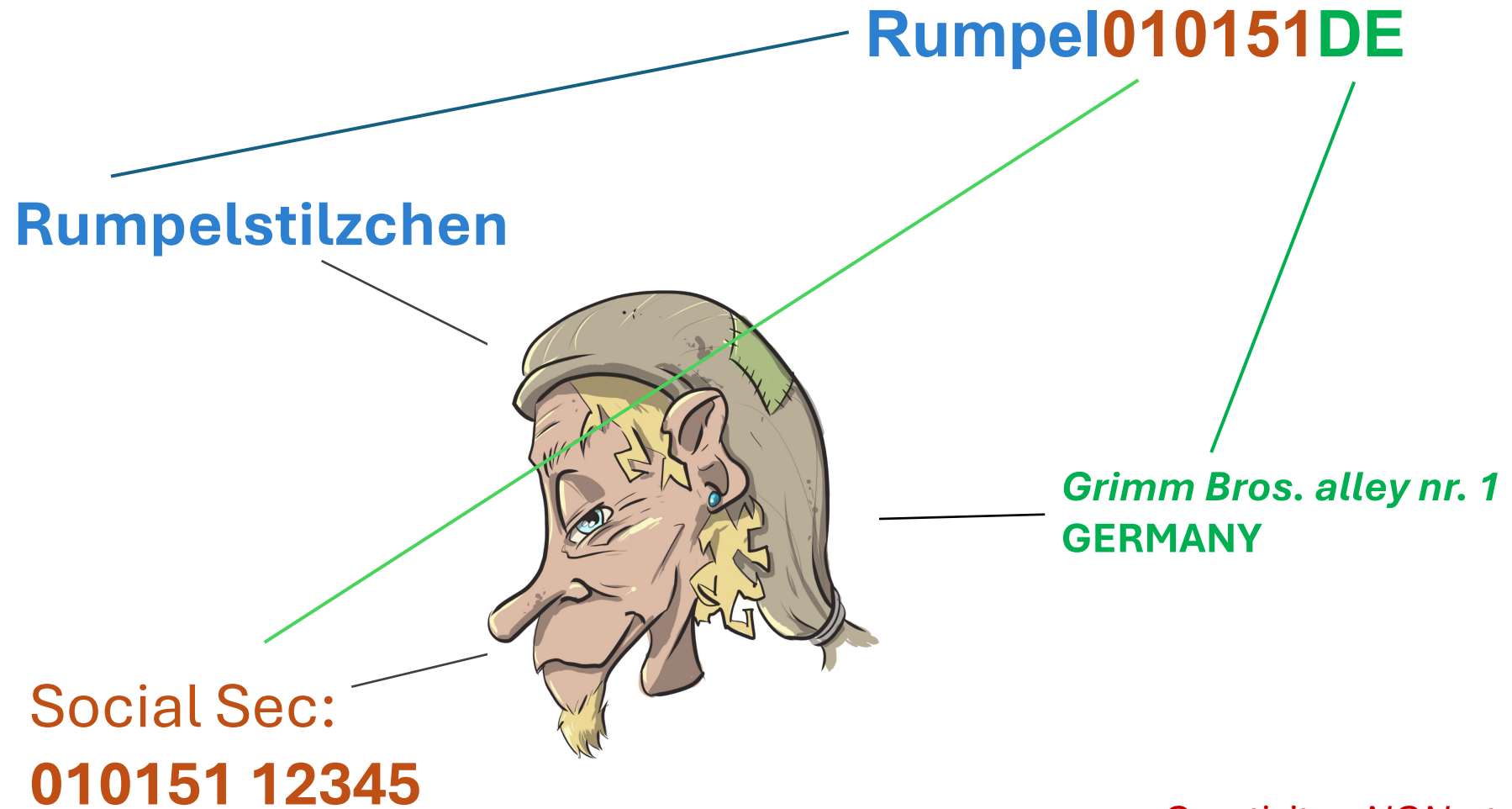
%Type
%QMA1 – Ball valve

Under construction

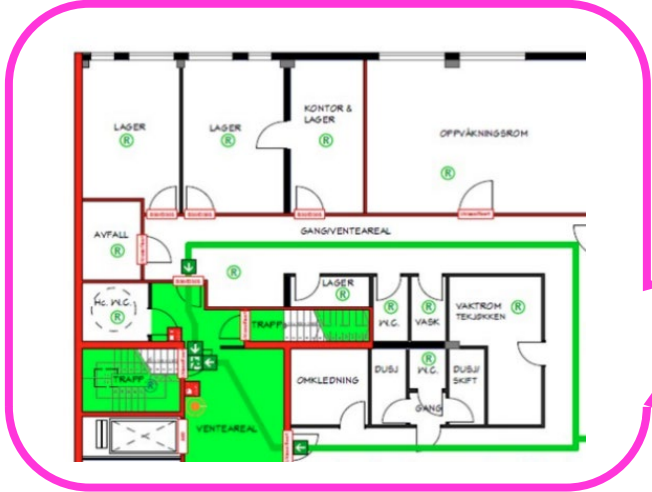
= Function
=Unit1=MIV=Bypass valve



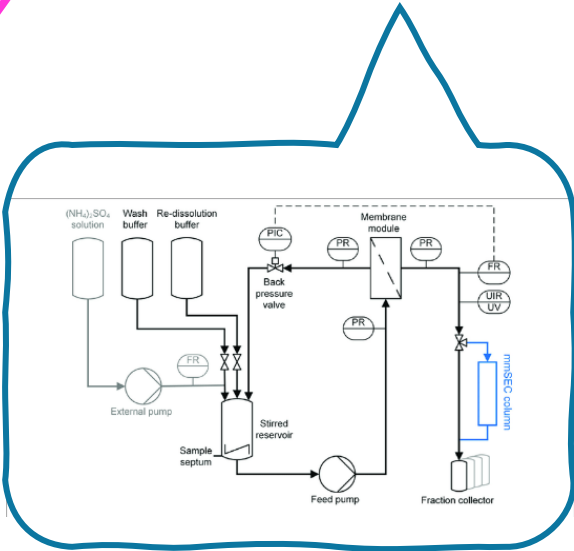
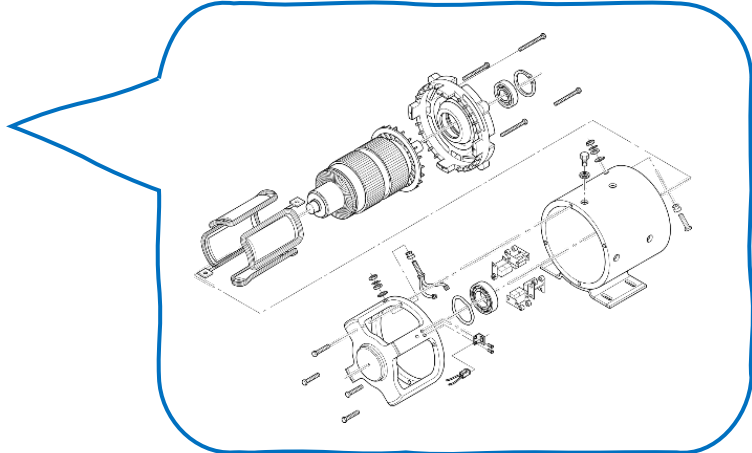
- Product
-HPHydraulics-Mod2-Filter6





Creativity = NON-standard



$$+R2=A1-G4$$



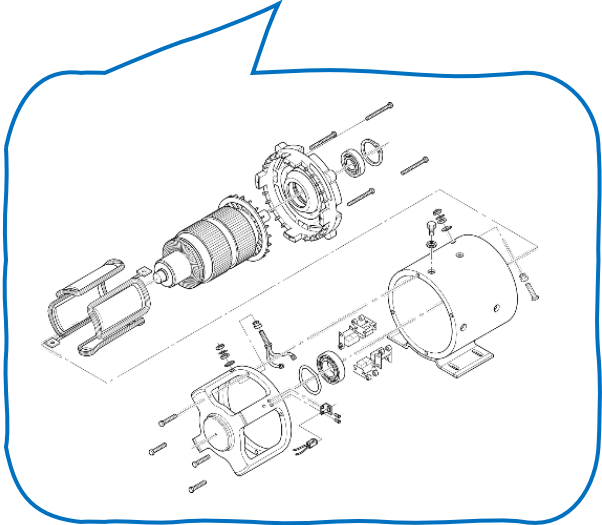
 $+R2=A1-G4$

 $\left\{ \begin{array}{l} -B5.A1.LSW4 \\ +A2.HJ14.FG4 \\ =A1.HG3.GGR1 \end{array} \right.$

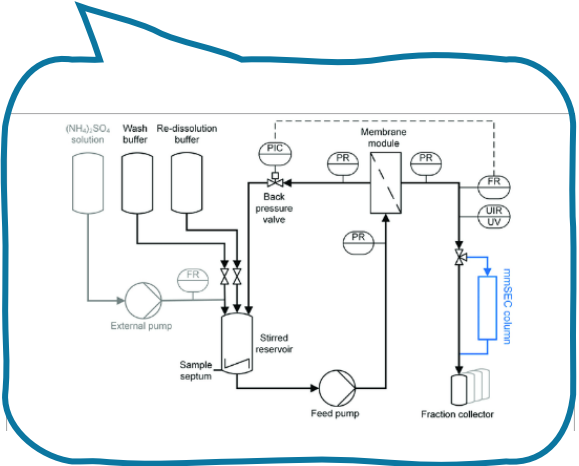
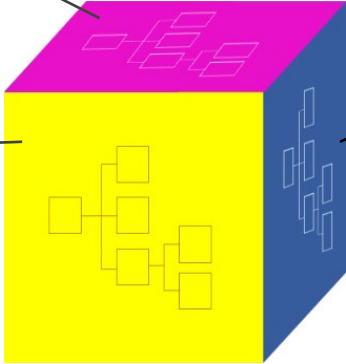
+ Location



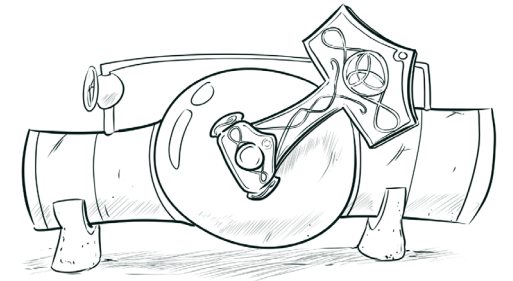
- Product



= Function

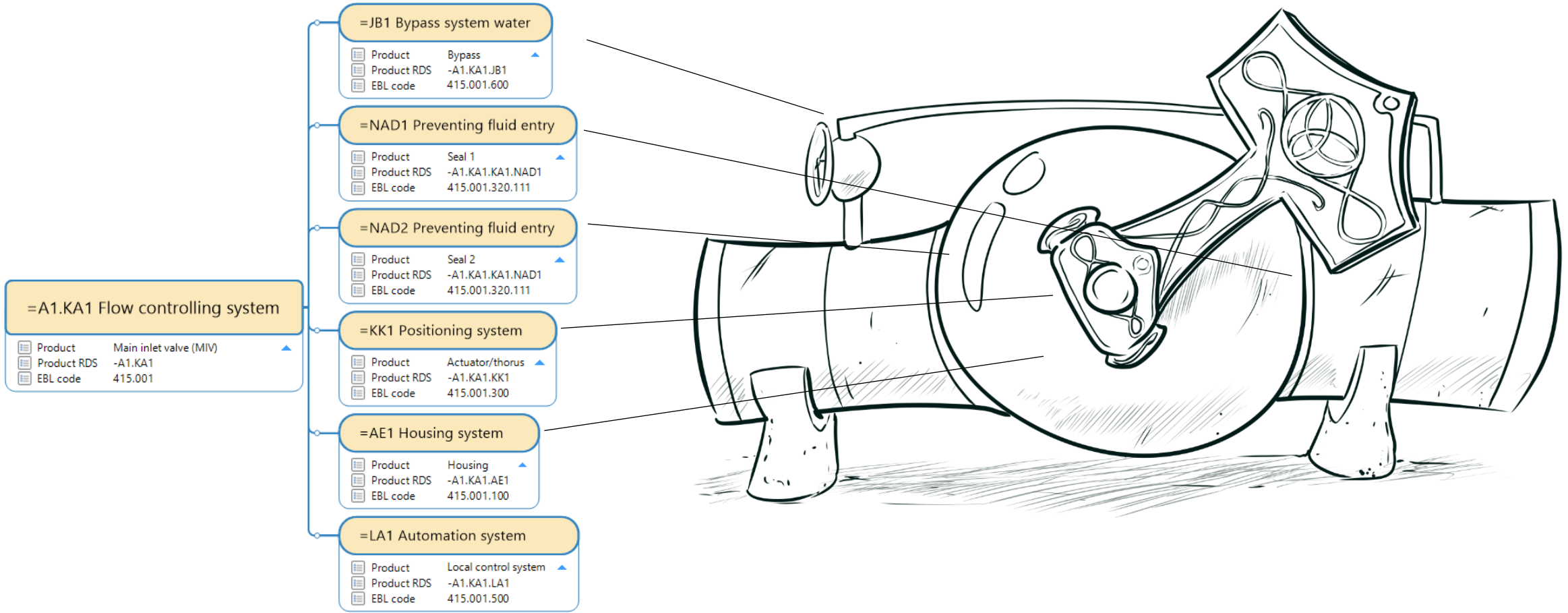


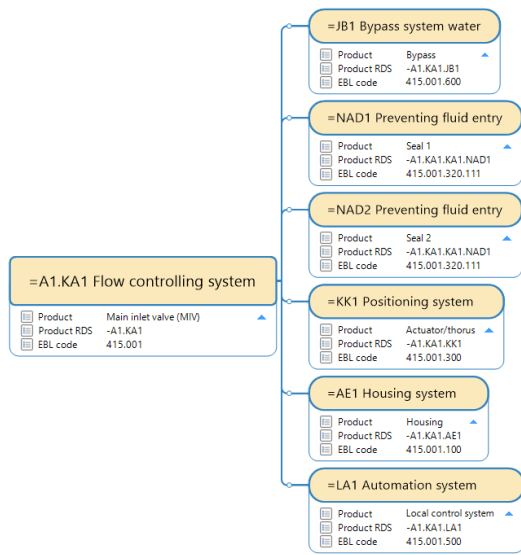
Step	Description (IEC 60300-3-11)	Butterfly Valve Example (Hydro Plant)
1. Define Functions	Clarify what the asset must do under normal operating conditions.	Valve must reliably open/close, provide sealing, and allow safe isolation.
2. Identify Functional Failures	List ways the asset can fail to meet its functions.	Valve cannot open fully, cannot close tightly, leaks under pressure, or operates too slowly.
3. Failure Modes & Effects Analysis (FMEA)	Identify specific failure modes and their effects.	Seal wear → leakage; actuator failure → valve stuck; corrosion → reduced sealing; bearing wear → sluggish movement.
4. Evaluate Consequences	Assess safety, environmental, operational, and economic impacts.	Leakage → reduced efficiency, flooding risk; stuck valve → turbine trip; slow closure → safety hazard during emergency shutdown.
5. Select Maintenance Tasks	Choose preventive, predictive, or corrective actions.	Regular seal inspection, condition monitoring, periodic functional testing.
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LEGACY (6500+ classes)

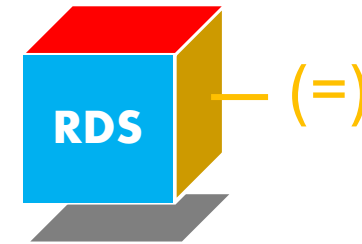
Functional failures :

- 1245 - Cannot close
- 6120 - Cannot open
- 6440 – Error in the opening of main valve
- 0245 – Oil spill
- 6542 - Not fully open
- 2545 - Not fully close
- 3354 – Seal broken
- 0415 - Slow operation
- 0458 - Remote control issues

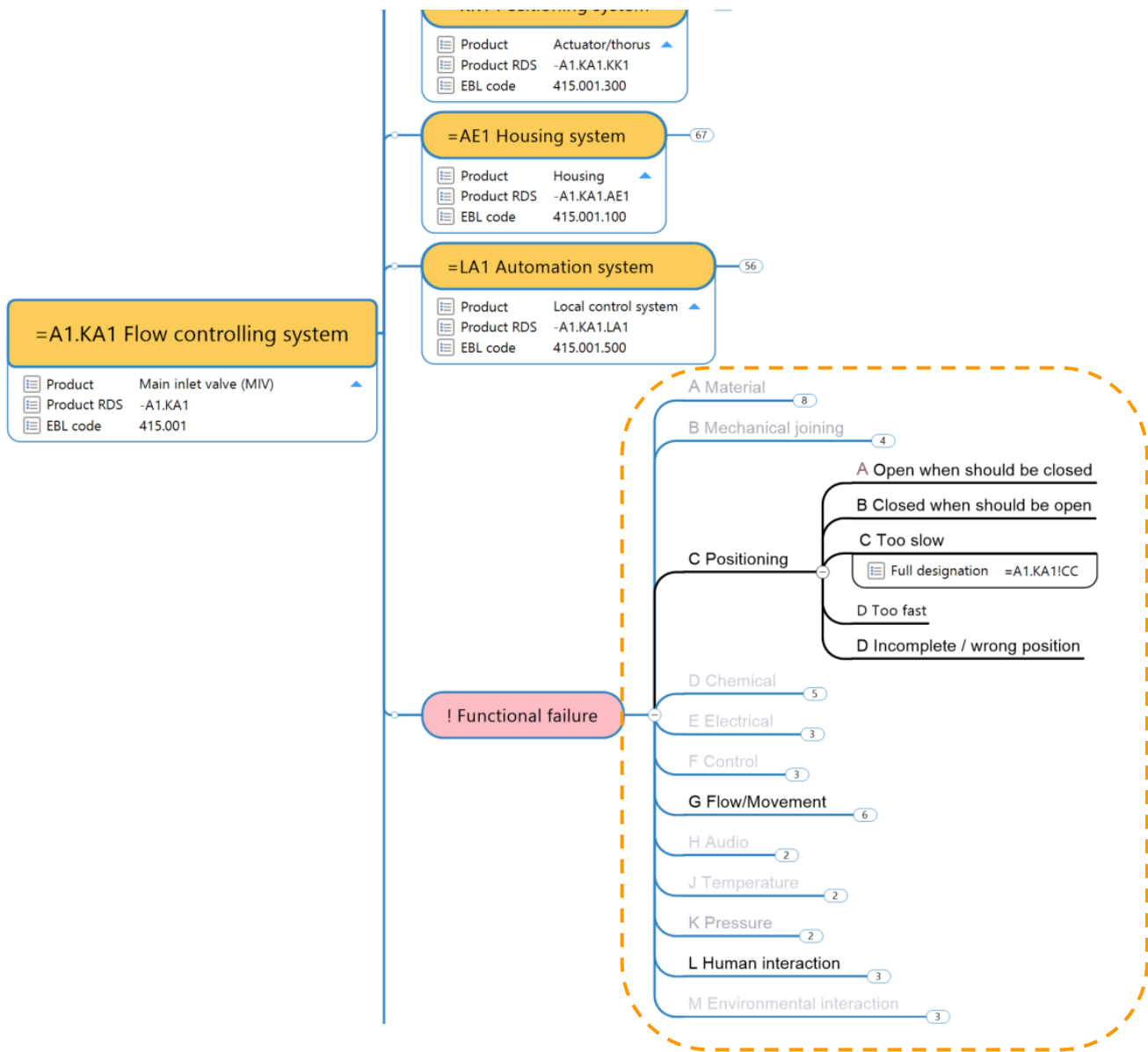
...

V/S

RDS (about 50 classes)



Functional Failures
(functional aspect)



Functional Failures (FF) in the functional aspect



First level		Second level	
A	Material	A	Corrosion
		B	Erosion
		C	Fatigue
		D	Overload / Structural weakness
		E	Structural Deformation
		F	Surface state
		G	Cavitation
		H	Integrity compromised
B	Mechanical joining	A	Unintentional loose
		B	Unintentional Contact
		C	Bad contact when contact is expected
		D	No contact when contact is expected
C	Positioning	A	Open when should be closed
		B	Closed when should be open
		C	Slow
		D	Fast
		E	Incomplete / wrong position
D	Chemical	A	Poluted
		B	Coated
		C	Reacting when unintended
		D	Not reacting as intended
		E	Unwanted coloring
E	Electrical	A	Without power
		B	Without earthing
		C	Discharging
F	Control	A	Not responding
		B	Unreliable
		C	Wrong response
G	Flow/Movement	A	Leaking
		B	Obstructed
		C	Blocked
		D	Vibrating
		E	Slow
		F	Fast
H	Audio	A	Causing unwanted noise
J	Temperature	A	Hot
		B	cold
K	Pressure	A	unpressurized
		B	too high pressure
L	Human interaction	A	Disabled
		B	Disconnected
		C	Removed
M	Environmental interaction	A	Fauna
		B	Flora
		C	Local ambient conditions



!HA – Causing unwanted noise

	Description
!HA1	<70dB Noticeable
!HA2	<85dB Avoid prolonged exposure
!HA3	<120dB Mandatory protection
!HA4	>120dB Critical



First level		Second level	
A	Material	A	Corrosion
		B	Erosion
		C	Fatigue
		D	Overload / Structural weakness
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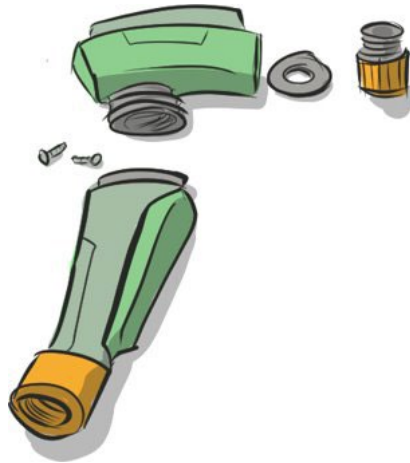
!BA – unintentional loose

!BA!HA3 - unintentional loose, causing unwanted noise

!HA3 – unwanted noise



Step	Description (IEC 60300-3-11)	Butterfly Valve Example (Hydro Plant)
1. Define Functions	Clarify what the asset must do under normal operating conditions.	Valve must reliably open/close, provide sealing, and allow safe isolation.
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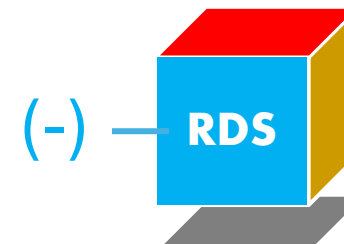
LEGACY (6500+ classes)

Failure modes :

- 1244 - Cooling failure
- 6120 – High pressure
- 6440 – Aging
- 0245 – Mechanical wear
- 6542 – Operator failure
- 2545 – control system fault
- 3354 – Weakness in coil head insulation
- 0415 - Slow operation
- 0458 - Remote control issues
- ...

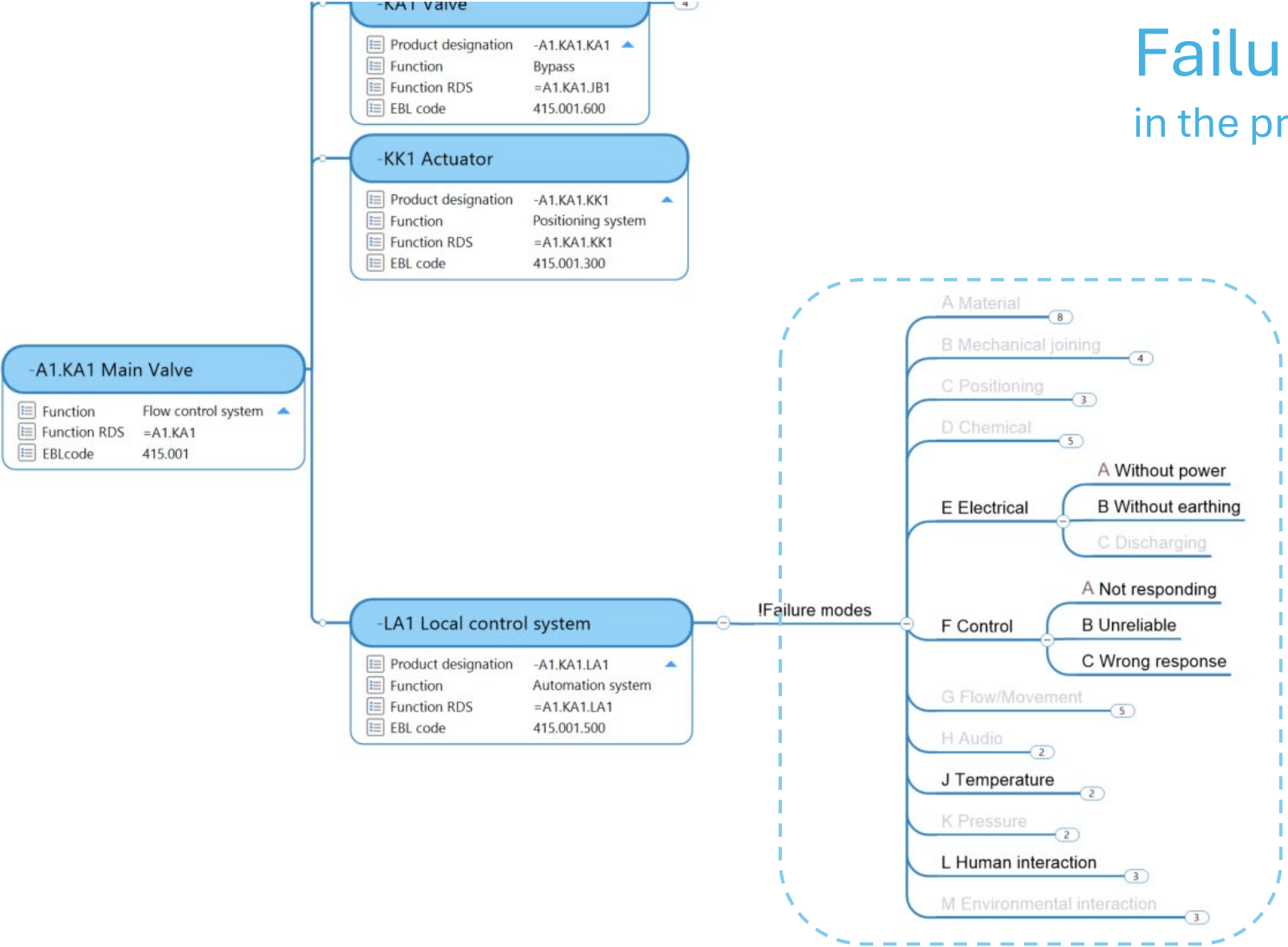
VS

RDS (about 50 classes)



Failure modes (Product aspect)

Failures Modes (FM) in the product aspect



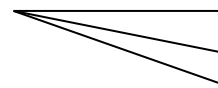


LEGACY FMEA

Manual task – not necessarily standardized

Failure modes :

- 0458 - Remote control issues
- 1244 - Cooling failure
- 6120 – High pressure
- 6440 – Aging
- 0245 – Mechanical wear
- 6542 – Operator failure
- 2545 – control system fault
- 3354 – Weakness in coil head insulation
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- ...



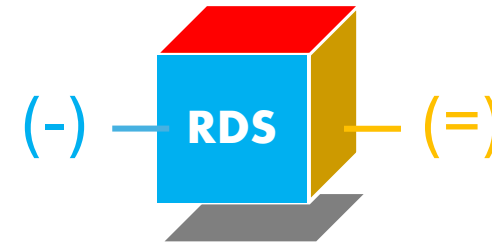
Effects:

- Operation disruption
- Unreliable open/closing
- Henrik should be fired
- ...

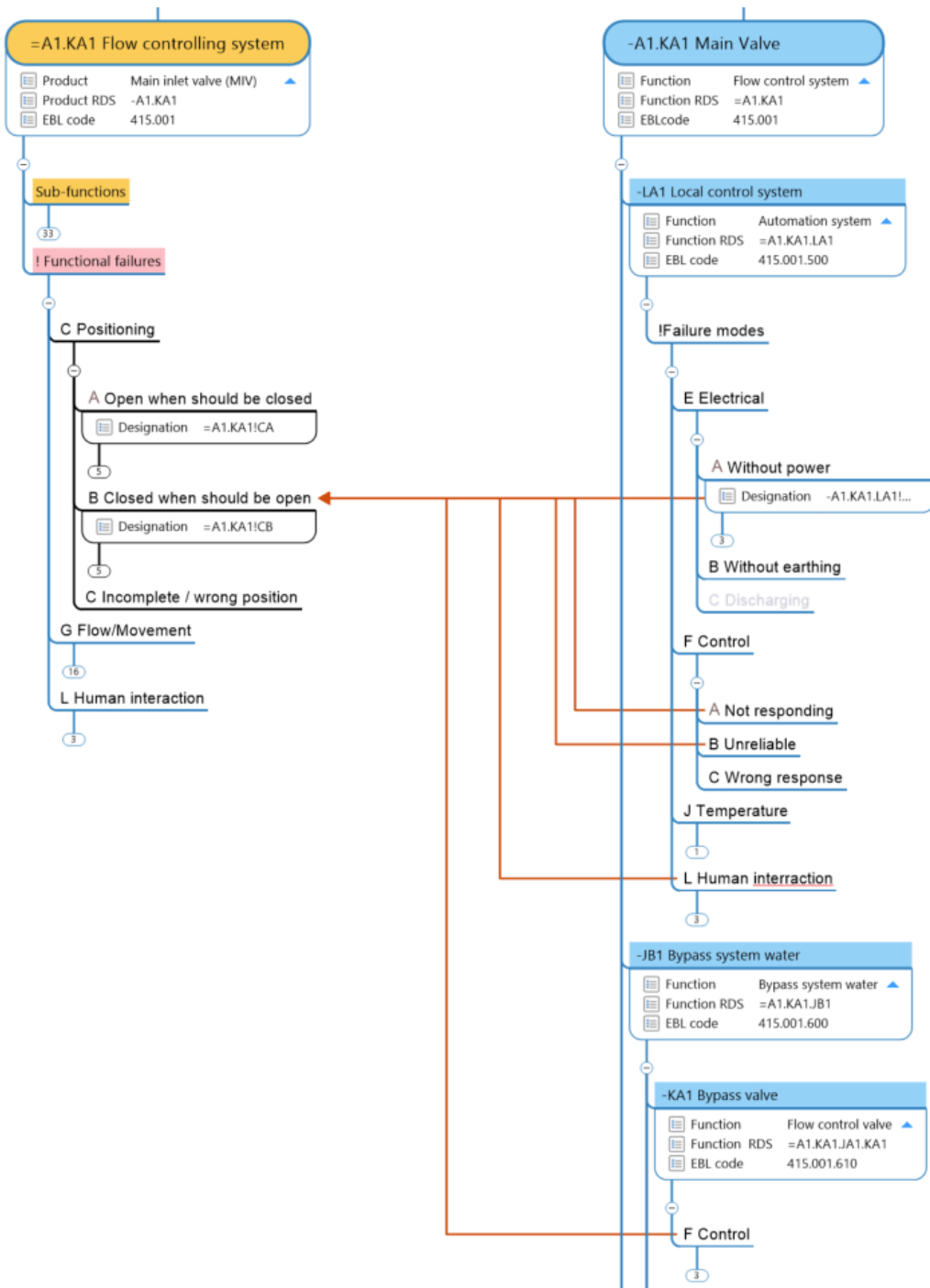


Step	Description (IEC 60300-3-11)	Butterfly Valve Example (Hydro Plant)
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VS



RDS based FEMA



=A1.KA1.JB1!CB |XA| -A1.KA1.JB1.KA1!EA

Function: Main inlet valve

Functional Failure: Closed when should be open

Relation: Can be caused by

Product: Main inlet valve, bypass valve


Failure mode: Is unpowered

LEGACY & RDS: Manual evaluation



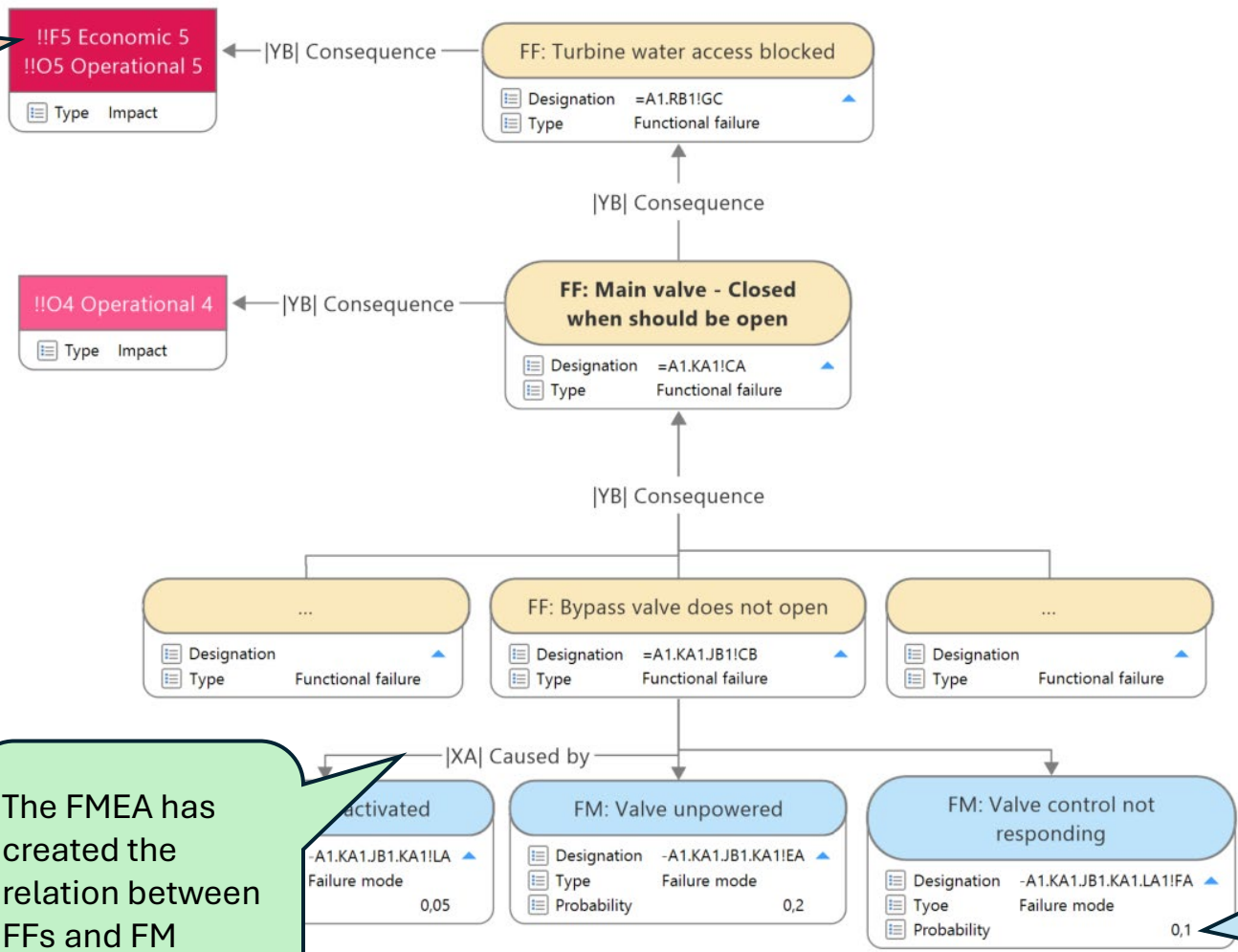
Step	Description (IEC 60300-3-11)	Butterfly Valve Example (Hydro Plant)
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Prefix	Code	Class
!!	H	Safety
!!	E	Environmental
!!	O	Operational
!!	F	Financial



RDS based Consequence Evaluation

Consequences are classified and evaluated in the functional aspect



The FMEA has created the relation between FFs and FM

Probabilities of failure modes are evaluated in the product aspect

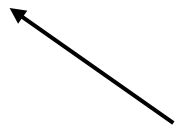


Example of a finding from the analysis:

The main valve will not be operable if there is a problem with the power supply system to the bypass valve.



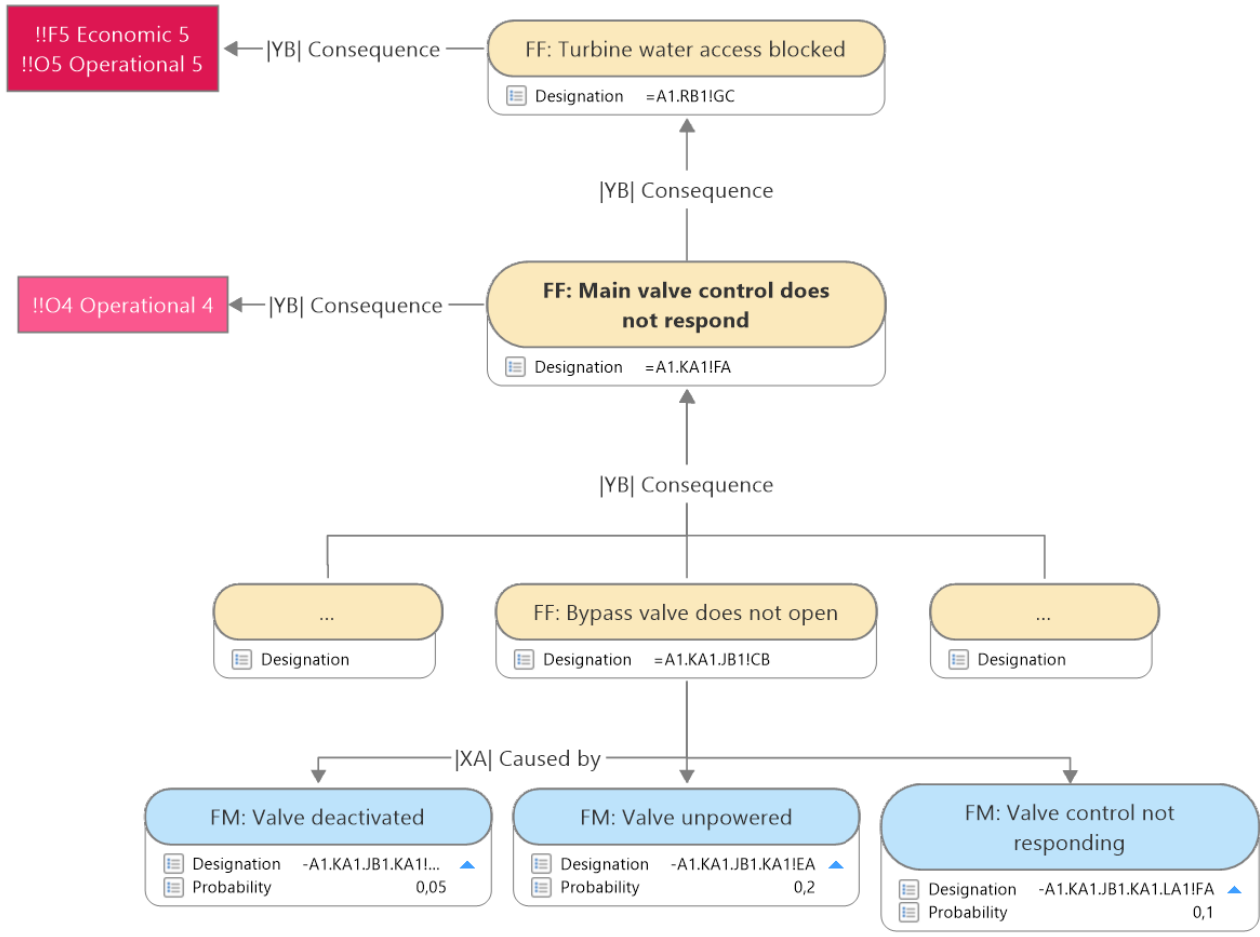
I knew
that
...



Not impressed



Hi!
I'm new here!
I had no idea!





RDS could be relevant, but not within this proposal

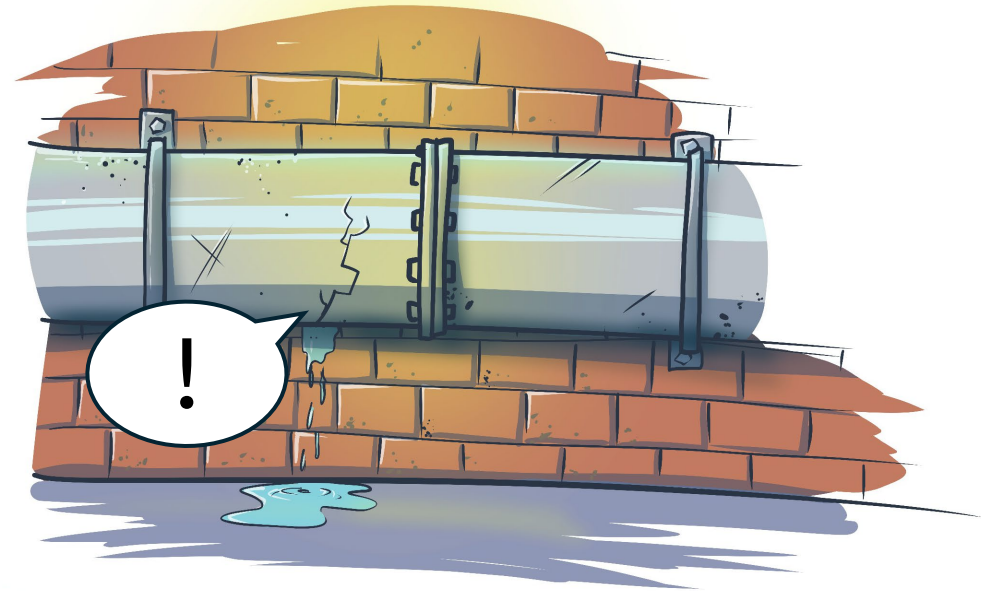


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State classification

Class	Class name
A	State as expected
B	Detectable warning state
C	Detected degradation state
D	Functional sub-optimal state
E	Functional critical state
F	Failed state
H	Hidden failure state
N	Functioning when not required
U	Unknown state
S	Fail-safe state

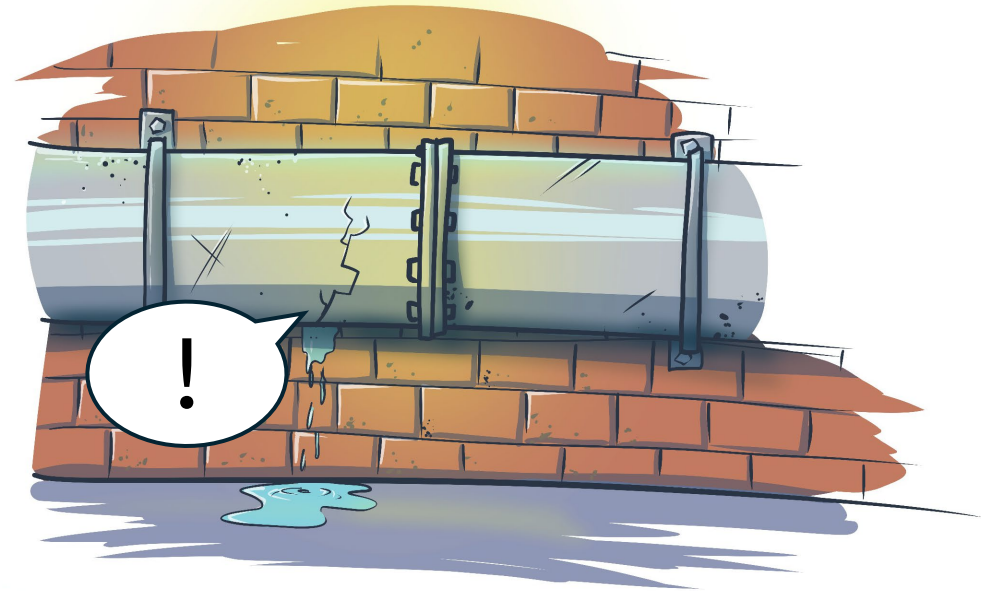
=D1.JB1!**GA**
Water transport! **Leaking**



State classification

Class	Class name
A	State as expected
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C	Detected degradation state
D	Functional sub-optimal state
E	Functional critical state
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H	Hidden failure state
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S	Fail-safe state

=D1.JB1!**E.GA**
Water transport! **Critical State**.Leaking

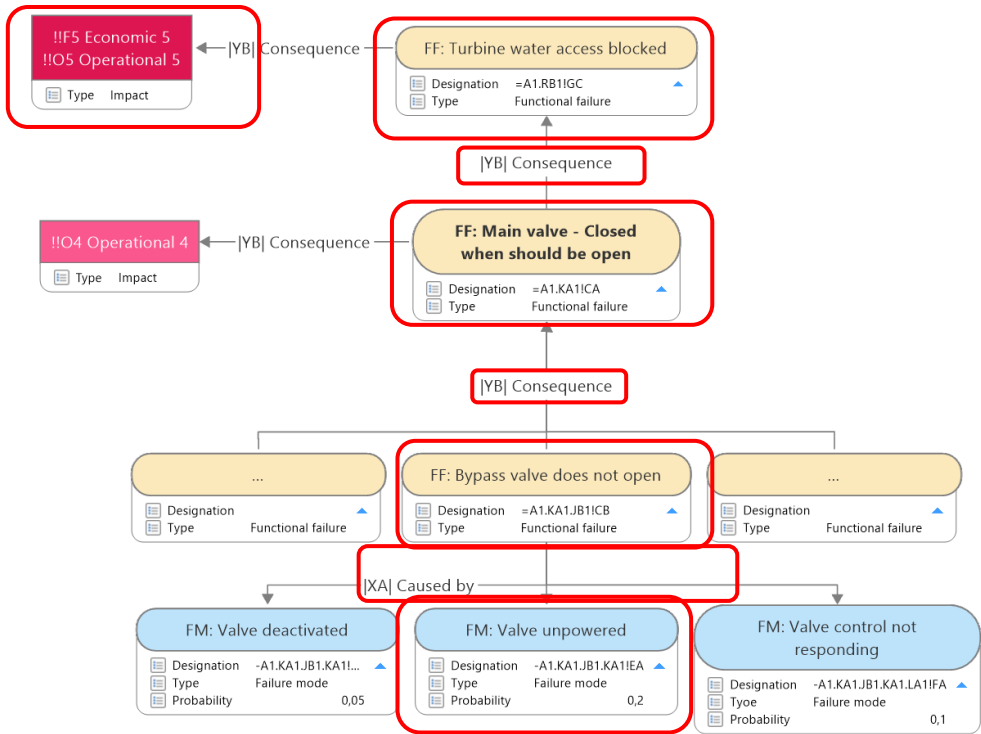




what's with
all the codes?

mhm...

=A1.RB1!GC!!F5 | YB | =A1.RB1!CA | YB | =A1.KA1.JB1!CB | XA | -A1.KA1.JB1.KA1!EA

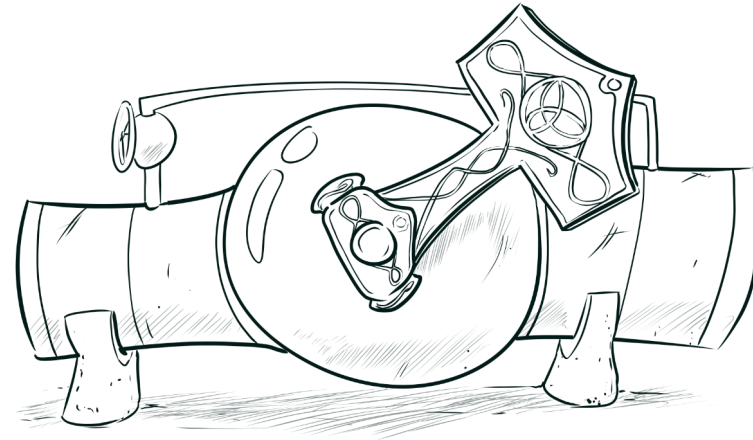


High risk of severe economic impact if
 Turbine water flow blocked
 a consequence of
 main valve closed when should be open
 a consequence of
 main valve bypass does not open
 can be caused by
 bypass valve unpowered

=A1.RB1!GC!!F5 | YB | =A1.RB1!CA | YB | =A1.KA1.JB1!CB | XA | -A1.KA1.JB1.KA1!EA

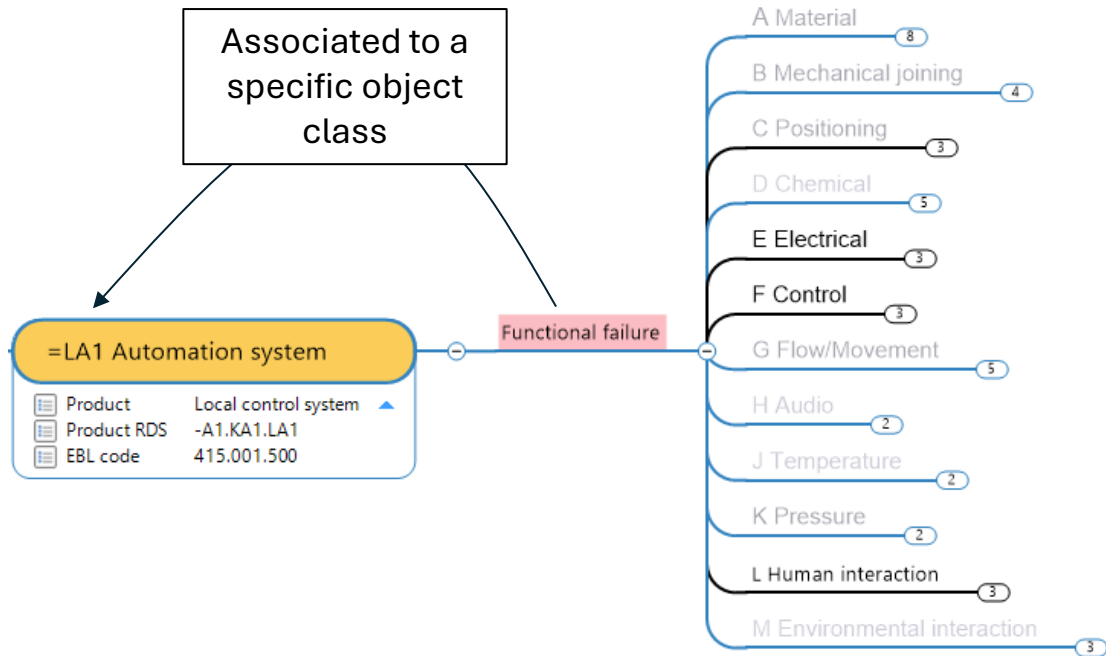


can't you just say it? I
don't understand all
these codes...



RDS (Digital name): -A1.KA1
Description: Unit 1, Main valve

Benefit nr. 1



Standardized application of templates is possible.

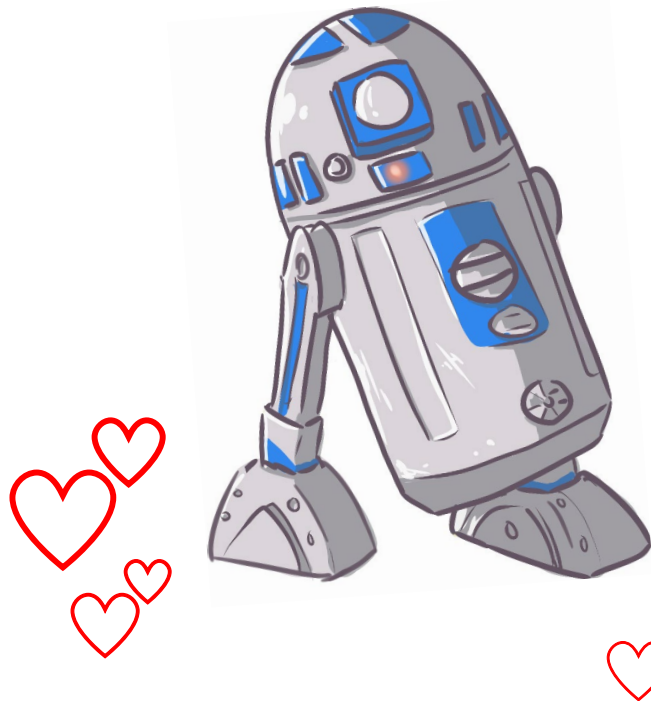
Benefit nr. 2



omg...

High risk of severe economic impact if
Turbine water flow blocked
a consequence of
Main valve controls not responding
a consequence of
Main valve bypass will not open
can be caused by
bypass valve unpowered

Benefit nr. 2



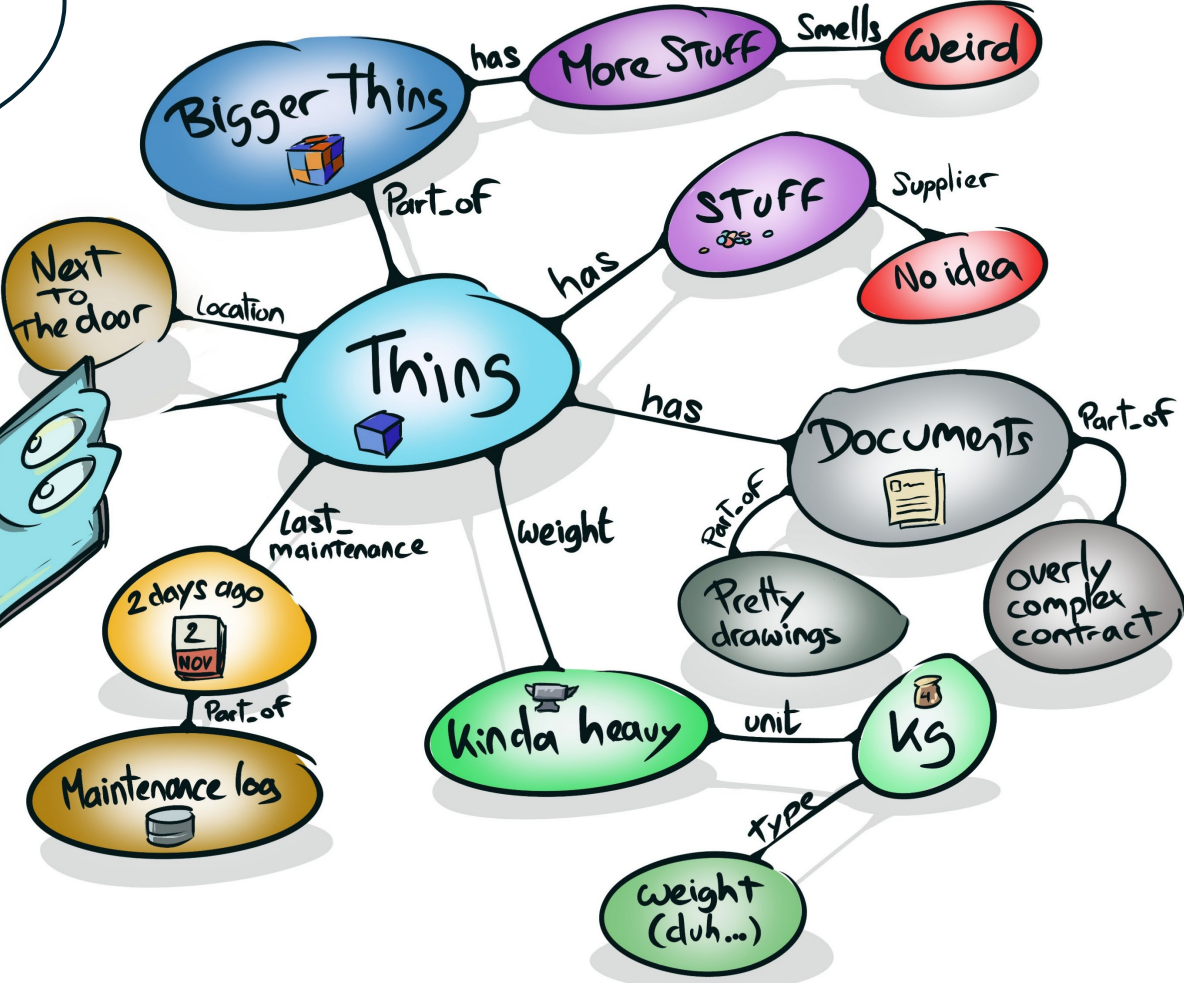
~~High risk of severe economic impact if
Turbine water flow blocked
a consequence of
Main valve controls not responding
a consequence of
Main valve bypass will not open
can be caused by
bypass valve unpowered~~

=A1.RB1!GC!!F5 |YB|=A1.RB1!GC |YB|=A1.KA1.JB1!CB |XA|-A1.KA1.JB1.KA1!EA



RDS = AI-ready

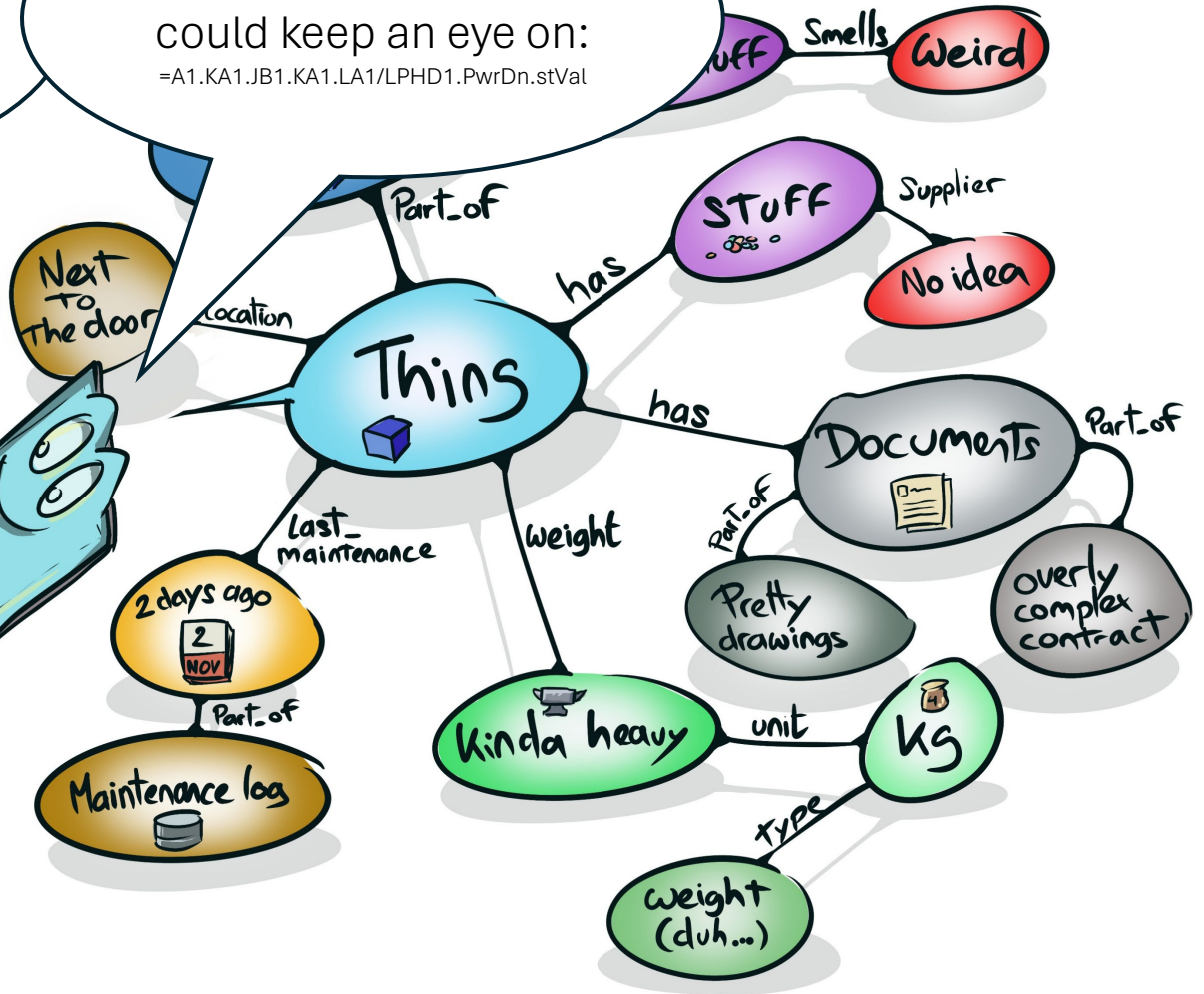
You should make sure the bypass valve power can't fail!

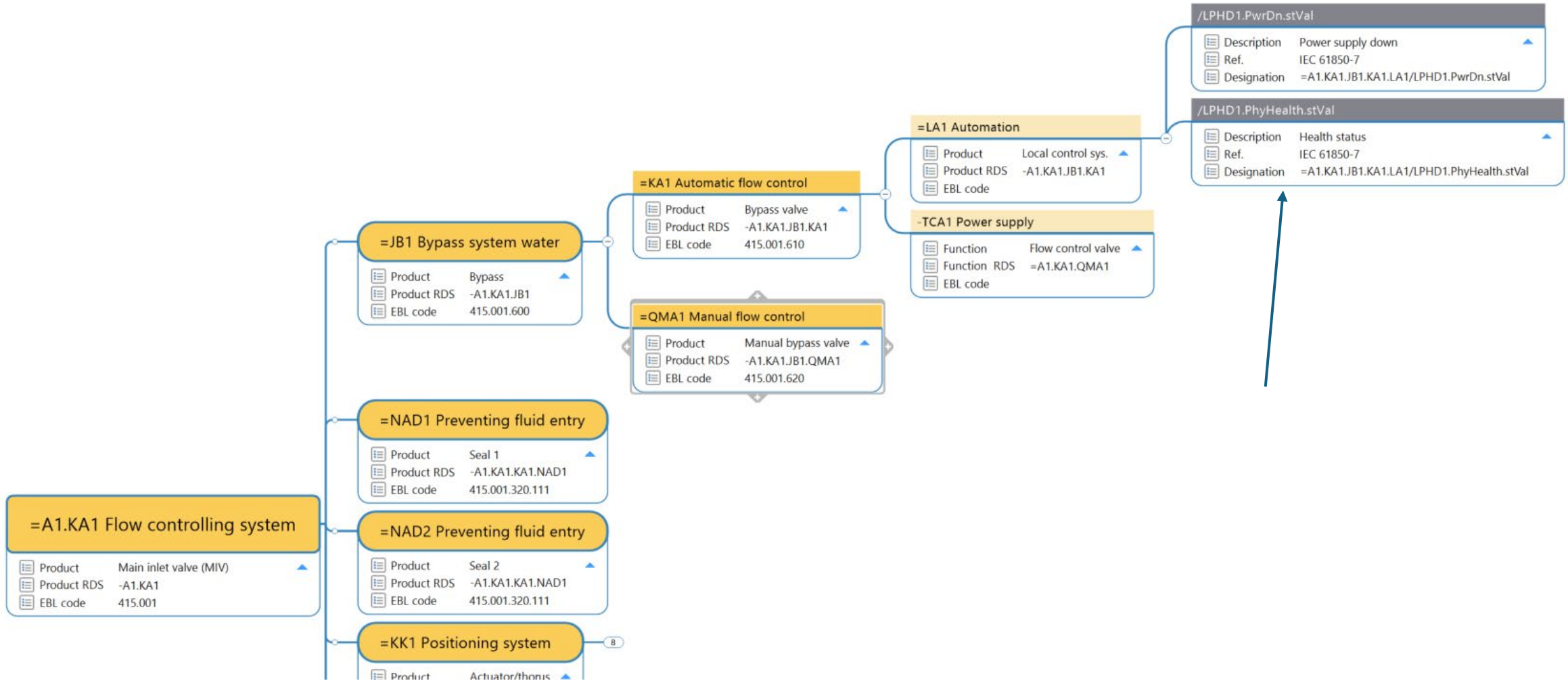




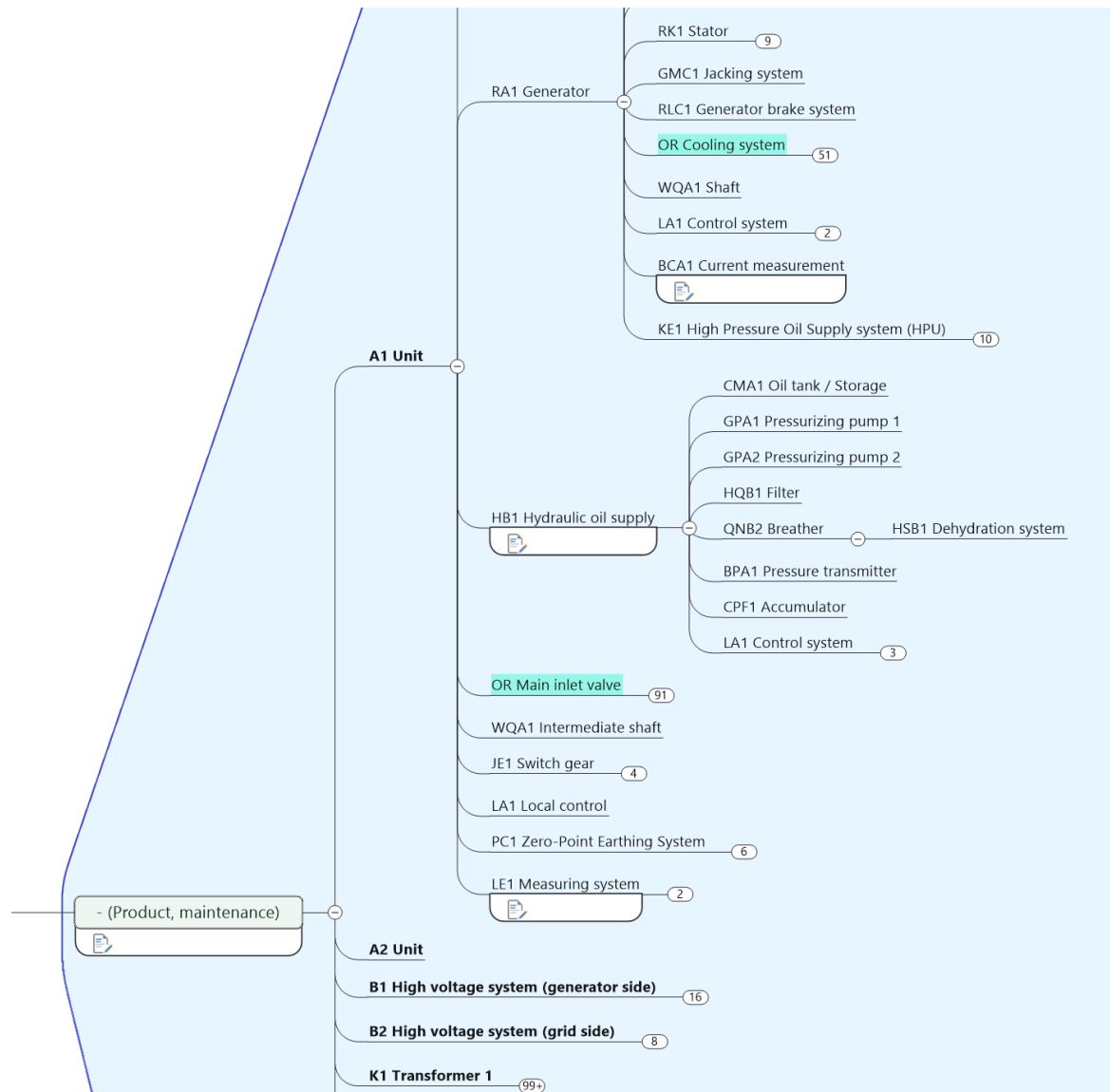
You should make sure the bypass valve power can't fail!

Here is a signal you could keep an eye on:
 =A1.KA1.JB1.KA1.LA1/LPHD1.PwrDn.stVal





Å
ENERGI





RDS

TC3: Structuring of
information

RCM

TC 56: Risk
assessment

! or ; or ???

IEC 81346
or
IEC 60300
or
???

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		C	Fatigue
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		E	Structural Deformation
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