RISK ANALYSIS SUPERHEATED WATER BOILER – FLUCAL WH140 NF-512

RISK CLASSIFICATION MATRIX

Risk matrix	Negligible (1)	Low (2)	Marginal (3)	Critical (4)	Catastrophic (5)
Frequent (5)					
Likely (4)					
Occasional (3)					
Remote (2)					
Unlikely (1)					

High

Average

Low

Factors	*Cause*	*Risk*	*Consequences*	Sev.	Prb.	NR	*Comments*
Pressure	Increase in pressure above maximun allowable pressure “PS”.	Plastic deformation; Rupture or explosion with consequente fluid leakage.	Overhaul calculation pressure and raise material strength above allowable values.	5	1	5	Suitable project - Use of 2 calibrated safety valves, use of redundant electrical and electronic excess pressure limiting systems SIL3 and safety PLC
Temperature	Overheating	Plastic deformation, rupture or explosion with consequente fluid leakage.	Decrease of material yield strength.	5	1	5	Adequate design - Use of redundant electrical and electronic equipment for excess pressure SIL3 and lack of water SIL3, use of safety PLC

Internal Fluid (water)	Inadequate fluid quality	Material corrosion and plastic deformation due to cooling shortage	Silt formation;Corrosion; Thickness loss	4	1	4	Consider corrosion metal wastage of 1 mm; Sample recover point to evaluate fluid proprieties; Installation of sludge purge valves; Installation of water treatment system
External Protection	Lack of maintenance on equipment painting and thermal coating	Appearance of corrosion	Serious burns in people; Removal of equipment from service due to lack of thickness	4	1	4	Equipment properly thermally insulated with mineral wool; The use of protective gloves is mandatory when operating the equipment.
Internal Protection	Inadequate fluid quality	Appearance of corrosion	Removal of equipment from service due to lack of thickness	2	1	2	Consider corrosion metal wastage of 1 mm; Use of treated water
Service break	Breakdown	Material corrosion and weakning at the restart.	Corrosion	2	2	4	Completely drain of the ESP with opening of manhole doors or for short periods, its total filling with positive pressure (around 0,5 bar).

Loads on pipes	Loads above allowables due to external nozzles action.	Cracks and leaks with loss of pressure.	Deformations in branches	3	1	3	No efforts were aplied on the pipes; Assembling connections shall be made with caution assuring stress transfer do not occur to the nozzles of the equipment.
Impact	Violent impacts due to load/ unload/ transportation actions	Damage in the equipment, eventually not visibles at the “naked eye”, who might cause its colapse.	Equipment damage, including nozzles.	4	1	4	Equipment moving shall be made at empty state through the use of lifting lugs and respect security procedures and warnings.
Maintenance	Insufficient periodic examinations.	Leaks, deformations and eventually equipment colapse. Non compliance with current legislation.	Insufficient following of the state of the equipment with possible occurence of corrosion not detected in time.	4	1	4	Incorporate in the Instruction and Maintenace Manual all informations regarding a good maintenance program.
Operation	Operating errors, namely restarts and stops.	Deformations, cracks or colapse.	Uncontrolled variations of pressure/ temperature.	2	2	4	To minimize the risks, all operations shall only be made by certified personnel gradually and according to “Manual” indications. Equipment controled by a PLC.

Fire	Fire in the installation where the equipment is located	Deformation, explosion.	Equipment overheating	4	1	4	The installation must be equipped with firefighting equipment in accordance with current legislation (Law of the country where the equipment is installed).
Cyclic Load	Combined pressure and temperature variation due to starts and stops	Material fatigue	Cracking of materials and equipment components	4	1	4	Equipment with reduced stop and start cycles