Type of hazard	Hazard			Component	Potential consequences	Calculations done	Risk assessment Probability (P): 0 100% Severity (S): 0 100% P S		Base risk	Risk reduction measures A -inherently safe design B -safeguarding C -Information for use	Risk assessment after implementing risk reduction measures P S		Residual risk
Mechanical hazards	cutting parts			any	cutting damage		30	30	60	deburring parts (A)	10	30	40
	nign pressure	volume change during normal operation H2 production	due to humid assembling due to leakage due to	- (see material release)		x x	10 40 70	10 70 10	20 110 80	appr. cell design (A) salt drying (C)	5 20 70	10 70 10	15 90 80
		CI2 production H2O production HCI production due to heating	overcharge/overdischarge due to humid material (salt) due to humid material due to leakage	- - (see material release)	material release, explosion	x x x	40 15 50 40 100	100 70 60 10 10	140 85 110 50 110	definition of safe operation window (C) salt drying (C) salt drying (C) appr. cell design (A) appr. cell design (A)	20 5 20 20 100	100 70 60 10 10	75 80 30 110
		due to vapour pressure due to side-reactions	caused by furnace caused by short-circuit caused by side-reaction	-		x x	30 40 20 10	10 10 10 10 5	40 50 30 15	safety switchoff (A) appr. cell design (A) appr. cell design (A)	5 30 20 10	10 10 10 10 5	15 40 30 15 0
	material release		by salt	housing			30 30	80 80	110	appr. material selection	20 20	80 80	100
			by Na (vapour)	sealing ring feedthrough crucible ceramic of feedthrough			30 70 20 40	80 80 30 80	110 150 50 120	(A), salt drying (C)	20 60 20 20	80 80 30 80	100 140 50 100
			by Zn (vapour)	braze of feethrough crucible Al2O3 or glassy carbon crucible and housing			60 10 10	80 30 30	140 40 40	appr. material selection (A)	10 10 10	80 30 30	90 40 40
			by HCI by applying wrong potentials	feedthrough sealing ring metals metals			50 30 30 10	80 80 80	130 110 110 90	salt drying (C) definition of operating window (C)	50 30 15 10	80 80 80	130 110 95 90
		due to corrosion from outside	by humidity or oxygen	housing lid feedthrough			20 20 80	80 80 80	100 100 160	window (O)	10 10 80	80 80 80	90 90 160
			by insulation	sealing ring housing lid feedthrough sealing ring	material release, fire, injury		20 20 20 20 20	80 80 80 80	100 100 100	selection of appropriate materials (A)	10 10 10 10	80 80 80 80	90 90 90 90 90
			by chemical lab vapours (HCI)	housing lid feedthrough sealing ring			20 20 20 20	80 80 80			10 10 10 10	80 80 80 80	90 90 90 90
		due to thermal shock	manufacturing defect bad welding	feedthrough crucible any feedthrough, housing		×	80 30 20 40	80 80 80 80	160 110 100 120	definition of heating/cooling rate (C) pressure test (A)	20 10 0 0	80 80 80 80	100 90 80 80
		due to abuse	bad swadgelok bad torque of sealing ring falling down	swadgelok sealing ring			30 30 10	80 80 80	110 110 90	definition of safe torque (C)	0 10 10	80 80	90 90
		due to aging	lifting cell at feedthrough etc. penetration from outside thermal cycling by expansion of current	- - feedthrough			40 10 70	80 80 80	120 90 150	handling instructions (C) further tests required	10 0 70	80 80 80	90 80 150
		due to thermal stresses due to overheating	collector, pressing in feedthrough wire (see high pressure)	feedthrough			80	80	160		80	80	0
Electrical hazards		due to phase change due to abuse		crucible		x	10	80	90	handling instructions (C)	10	30	0 40
		due to power outage due to internal short	sheat failure self-discharge bridiging electrodes by deposited Zn	sheat salt cabling	overpressure		10 80 80 80	30 30 30 30	40 110 110 110		10 80 80 80	30 30 30 30	40 110 110 110
	_	and gas generation	deposited Na vapour and corrosion and corrosion	feedthrough	(see high pressure) (see corrosion) (see high pressure) (see corrosion)		60 15 15	30 90 90	90 105 105	definition of operating window	60 5 5	30 90 90	90 95 95
	power outage				(see material release) (see short-circuit)		70	40	110		70	40	110
	outside corrosion				burning fingers (see material release)		30	30	0	instructions for use (C) selection of appr. materials (A)	10	30	0
	overneating	due to failure of temperature controller due to removal or broken thermocouple			(see overpressure)		20 20 40	80 80 80	100 100 120		20 10 10	80 80 80	100 90 90
		active metals co-deposited metals		Na, Zn Li, Ba, K, Sr, Ca					0 0 0				0 0 0
		salts structural material corrosion products	Ni, Cr, Fe chlorides Mo, W chlorides CuCl, CuCl2 Ag, Au chlorides Oxides Hydroxides	BaCl2, NaCl, ZnCl2, CaCl2, KCl, SrCl2 alumina, alumina fibres housing currenct collector sealing ring feedthrough humidity humidity	(not included below) (not included below)				0 0 0 0 0 0				0 0 0 0 0 0
	specific material hazards	skin	corrosion	alkali metals, many chlorides	(not included below)				0				0
		flammable toxic to aquatic life	irritation gas solid	Na, Ca, Li, Ba, K, Sr Ba Zn, Cu, Ag, Cr, Mo					0 0 0				0 0 0
		eye explosive harmful/toxic	irritation damage after air contact if swallowed in contact with skin if inhaled	chlorides many substances K-peroxide Ba, most chlorides CuCl2, CuCl BaCl2, NiCl2, HCl, Cl2	injury, intoxication, damage				0 0 0 0 0	Wear gloves and eye protection (C), disassembe in fumehood (C), operate under fumehood (C)			0 0 0 0 0
		allergy or asthma CMR damage to unborn child damge to organs corrosive to metals	genetic defects carcinogenic	Au, Cr, Fe, Ni chloride NiCl2 NiCl2, ceramic fibers NiCl2, LiCl Ni, Cr, Mo chlorides, Cl2 Ag, Cr, Fe, Cu chlorides					0 0 0 0				0 0 0 0 0
		aerosol vapour gas	all Na, ZnCl2 PH3 made from phosphorous in alumina, phosphide and				70 70 50	95 95 95	165 165 145	Operated and disassemble under fumehood (C)	10 10 10	95 95 95	105 105 105
Hazards		skin	water	CuCl2	external corrosion	\vdash	80	80	160	wear gloves (C) Select appr. materials	10	80	90
associated with the environment	moisture fall over				(see material release) (see short-circuit)	x	10 10	80 40	90 50	(A)	10 10	80 40	90 50
	chemical substances (e.g.				(see material release)	l	10	30	40		10	30	40