Hazard Identification Analysis

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12. LEGAL FEES.

If any legal action or proceeding is brought for the enforcement of this Agreement or arises from the alleged breach, dispute, default or misrepresentation in connection with any of the provisions of this Agreement, the prevailing party or parties shall be entitled to recover reasonable legal fees and other costs incurred as a result of such legal action or proceeding.

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No failure to enforce any term of this Agreement shall constitute a waiver of such term in the future unless such waiver so provides by its terms.

14. ASSIGNMENT.

Neither this Agreement nor any of the User's rights or obligations hereunder may be assigned by the User in whole or in part without the prior written approval of the Company. Any other attempted assignment shall be null and void.

15. SEVERABILITY.

If any part of this Agreement is for any reason found to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions of this Agreement shall not be affected and same shall remain in effect.

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This Agreement is the complete and exclusive statement of the agreement between the Company and the User with respect to its subject matter, and supersedes and voids any proposal or prior agreement, oral or written, and any other communications between the parties in relation to its subject matter. No waiver, alteration or modification of this Agreement shall be valid unless made in writing and signed by a corporate officer of the Company.

HAZARD IDENTIFICATION ANALYSIS

Hazid System: CA

System Title: New Anodise Line (CTF)

Original Assessment Date: 03/02/2022 & 14/02/2022
Revision Date:
Revision: 0

Brief System Description:

On the New Anodise Line, Aluminium & Titanium Components are processed. The line consists of 28 stages. Components are loaded onto the flight bar (three transporters) , then automatically transferred to the relevant tanks based on a recipe.

The following information is provided below the HAZID:

Block Flow of the Line - Showing an idealised process as an overview
Process Steps - Showing the typical processes that may be selected
Tank Chart - Showing the chemicals in each tank
Tank Summary Table - Showing the equipment and processes relating to each tank
Chemical details / Incompatibilities
Sketch of study tank

All tanks bunded to >110% or 25% of the total tanks contents with acid / alkali segregation (can mix if very large volume). Level alarms on bund sumps which initiate evacuation and relayed to the gatehouse. All chemical tanks have an overflow into bund (rinse tanks have a weir to drain).

LEV is fitted to all chemical tanks, that passes off gases into a packed column water scrubber with release to atmosphere. When the transporter is over an open tank, a basic seal is formed between the transporter and the tank. LEV is fitted to the transporter which vents directly to atmosphere outside the building at height. Draeger system detects HF & Nitric acid vapour releases along the front and back of the line.

HAZID is selected as a suitable risk assessment process as it is the site standard and considered proportionate to the complexity of the relatively simple process. The HAZID is focused on scenarios where significant harm to people or the environment may occur due to process safety risks (COMAH hazards). It is not intended to be an exhaustive list of all risks (e.g. personal safety, quality). Where these were discussed, they were recorded by the project team for discussion elsewhere.

HAZID Process:
The tanks are designed to be very similar, using a modular approach. The process in each tank is specified and the technical requirements are identified (e.g. heating , cooling, filtration, aeration). See 'Tank Summary Table'. On this basis, it was agreed that a 'representative worst case' tank would be assessed in detail and then any significant variations considered. This is possible as the modular parts of each tank are built to the same standard. Based on the Tank Summary Table, Tank 9 was chosen as the basis for the assessment. A similar approach was adopted for the New PFD Line HAZID. The representative tank has:

16m3 tank constructed from stainless steel, PP or PVDF as appropriate to the chemicals
Close fitting lids which are PLC controlled
Lip extract on both long sides to a caustic scrubber
Heating coil using Low Pressure Hot Water (60'C)
Cooling coil from chiller unit
Air agitation fed from common main
Filtration pump and filter with eductor on end of return line to provide mixing
Bulk fill by Veolia bringing IBCs , pump and hoses to the line. Pump from IBC to tank via Blister. Rinse through pipes with water when complete
Bulk Drain by Veolia bringing vac tanker and hoses. Hose dipped into tank via blister (tank internal floor designed to fall towards blister side) and connected to waste line. Vacuum tanker removes contents.
When tank is drained and rinsed, waste line is flushed its full length.
Automatic Demin water top up from common main
Manual Demin water top up from common main
No penetrations in the chemical tanks below liquid surface (with the potential exception of station 23)
Overflow to bund
Air agetated Safetainer for dosing
Vent line from safetainer into head space of tank
Dosing pump draws liquid from safetainer and transfers to tank where it enters via an open ended pipe above the liquid level.
Radar level detection which turns on DI for automatic top up and turns it off again at high level. This device also alarms on HH or LL and stops additions and heating / cooling.
High level Sensor which alarms on HMI and isolates auto demin, demin main supply, LPHW (and steam on tank 23)
Two temperature sensors for control of the process
Additional temperature sensor for HH temperature which alarms on HMI and isolates LPHW (and steam on tank 23)
Assume chemical is Hydrofluoric Acid as worst case

Notes: Where a line is 'greyed out', this indicates that there are no significant safety / environmental hazards identified or the hazard is considered elsewhere in the HAZID.

References:
OP000103-32-001A New Anodise P&ID Examples from New PFD Line:
NHE 13-143-040 LPHW system example
13-143-032C - Scrubbers
13-143-015B - Safetainers
13-143-002B - Dosing
KOCH Anodisation Line Outline Design Review (13/01/2022)

Attendees:
T Stableford (Mtce)
S Coombes (Production)
M Charnley (Facilities)
A Parsonage (SHE)
L Hollin (SHE)
J Willis (Koch)
S Cartmel (Koch)
P Harley (HAZID Leader -Portman Risk Ltd)

SYSTEM: New Anodise Line (CTF)

Stages	Mark	Scenario Definition: Deviation	Cause and Initiating Event(s)	Hazard Scenario	Worst Case Unmitigated Consequences	Raw Risk: Type	S	L	Prevention, Control & Mitigation Safeguards: Inherent Safety Features (Process & Equipment Design)	Process Control Systems (Process Control, Interlocks, Alarms)	Physical Protection Systems (Pressure Relief, Bunds)	People & Procedures, (PPM, PPE, Management Systems)	Residual Risk: S	L	Risk	Recordings: Actions, Comments, and What more can be done?	Notes
Tanks																	
CA	1	Overpressure	Mechanical failure	Blockage of relief valve on Blower air for air sparges. Note: The system operates with two blowers on a common manifold to all tanks. The system normally vents excess air via the relief valve.	Increased flow to tanks which increases the effective volume of the tank contents - potential for splashing and injury of operator from tank contents (acids)	P	2	6	None identified	1. Draeger gas detectors may pick up higher levels of vapour 2. High level detection may be triggered by rise in level and raise alarm (automatic isolations will not remove the hazard)	1. Overflow to Bund 2. Splash guards and physical barriers around tanks on front of line. Distance guarding on rear. 3. Lids on all chemical tanks may limit splashing 4. Gaps in side cheeks etc will be as small as practical 5. LEV for removal of additional fumes	1. Maintenance have procedures for generating process risk assessments for access beyond guards and isolating air if this is the issue. 2. PPE for maintenance and operators when potential for splashing is possible. 3. Chemical & Emergency awareness training 4. Trained operators 5. Spill kits available	2	4	M	1. Blower relief valve to be on PPM 2. Consider the benefits of alternative methods of controlling pressure to minimise wasted air /energy (e.g. pressure sensor and VSD). Relief valve is likely to still be needed as ultimate protection.	0
						E	1	6					1	4	L		
CA	2	Overpressure	Human error	Valves closed in Blower air line	Low air pressure reduces agitation in the tanks. Quality issue - no significant safety hazard. Back pressure on blowers - blower damage Note: If air agitators are isolated on other tanks, this will increase the air vented via the relief valve rather than significantly increasing the air pressure at other tanks.	P	0	8	Pipework suitable for maximum fan pressure	None identified	1. Pressure relief on blower line 2. Overload on electrical supply to motor	None Identified	0	6	L	1. Confirm blowers have over temperature protection. 2. Blower relief valve to be on PPM	0
						E	0	8					0	6	L		
CA	3	Overpressure	Mechanical failure	Blockage in Blower air line due to chemical build-up , corrosion, foreign objects etc leading to failure of the pipe within the tank due to overpressure.	Leads to more air into the tank in a similar way to blockage of the relief valve	P	2	6	1. Maximum pressure of blower is below the maximum pressure rating of the pipework	None identified	1. Pressure relief on blower line	None Identified	2	3	L	1. Consider if it is practical to arrange the holes in the sparge pipes at 45 degrees facing down to avoid chemical build-up	0
						E	1	6					1	3	L		
CA	4	Overpressure	Human error	Maintenance error with fan wired up backwards sucking liquid up the air line from tank.	Expect reduced performance of fan rather than vacuum - **no significant safety hazard**	P											0
						E											
CA	5	Overpressure	Mechanical failure	Filter unit return goes to bottom of tank and has an eductor to mix tank contents - eductor falls off due to corrosion, impact , etc .	Quality issue - **no significant safety hazard**	P											0
						E											
CA	6	Overpressure	Mechanical failure	Filter unit return line goes to bottom of tank and has an eductor to mix tank contents - blocked. **OR** Hand valve shut after pump.	Filter system pressure increases. Pipe splits or filter lid seal passes. Corrosive sprayed onto nearby personnel	P	2	6	1. Maximum pump pressure is below the maximum pressure rating of the pipework and fittings.	None identified	1. Pipework containing corrosives is double skinned	None Identified	2	4	M	1. For each chemical filtration system, consider screening around safety critical leak points on corrosive chemicals to prevent splashing outside the bund and/or flange covers to prevent sprays.	0
						E	1	6					1	4	L		
CA	8	Over Temperature	Mechanical failure	Chemical Tanks is heated from a hot water coil fitted to the tank. LPHW	60ºC hot water cannot boil tank Unmanned operation saturday **No Significant Safety Hazards Identified**	P				1. Independent High temperature alarms will close valve to heating coil. 2. Auto demin top up on tanks to replace any drop in level due to evaporation.	1. Tanks are fitted with lids & lip extraction so fume emission is reduced					1. Check that low level shuts off hot water supply.	0
						E											
CA	9	Over Temperature	Mechanical failure	Tank 23 is heated from a steam coil fitted into the tank.	Failure of temperature control system leads to boiling of the tank and increased emission of toxic/ corrosive fumes	P	2	8	Not applicable	1. Independent High temperature alarms will close valve to heating coil. 2. Auto demin top up on tanks to replace any drop in level due to evaporation. 3. Draeger gas detectors may pick up higher levels of vapour	1. Tanks are fitted with lids & lip extraction so fume emission is reduced	Not applicable	2	5	M	1. Check that low level shuts off steam supply.	0
						E	1	8					1	5	L		
CA	10	Over Temperature	Corrosion / mechanical failure	Tank 23 is heated from a steam coil fitted into the tank.	Failure of the pipework allows the tank chemical to enter the steam pipework (during temperature control cycle negative pressure may occur, sucking liquid into the pipe). Chemicals then damage the steam system. **No Significant Safety Hazards Identified**	P			1. Heating coils located to avoid contact with the flight bar / components 2. Pipework is of suitable material for solution			1. Tank inspections include condition of heating coils				1. Check that low level shuts off hot water supply.	0
						E											
CA	11	Over Temperature	Mechanical failure	Electric Dryer overheats	Waste of energy only **No Significant Safety Hazards Identified**	P				1. Temperature probes shut down and provides alarm on operator panel						No further actions identified	0
						E											
CA	12	Overfilling	Human error	Overfilling of tanks due to incorrect manual charging of water	Loss of up to 16,000 litres of Toxic, DTE. Very Toxic or corrosives from Process tanks but being contained within the bund. May be release of toxic vapours. If doss run out of bund may leave site and go to Blackburn WWTW and ultimately river	P	2	8	1. Chemical Tanks fitted with overflows direct to bund which are positioned below the level of lip extraction to limit potential for liquid to enter LEV and not over edges of tank in uncontrolled fashion	1. independent high high level monitoring & alarm on chemical tanks (local / HMI audible and visual alarm and bund alarm at gate office). 2. High High level will shut down the water to the whole line. 3. Audible alarm fed from Level monitoring in the bund and relayed to Gatehouse 4. Draeger gas detection and alarm	1. Bunds 2. Manual isolation valves 3. Penstock to isolate outfall to WTWW	1. Minimum duration of manual interventions 2. Level instruments on PPM 3. Emergency procedures 4. Trained operators 5. Spill procedures and kits	2	4	M	1. Koch - Add ICV what is ICV ??? to main DI supply and close on HH on any tank	0
						E	4	8					4	4	L		

CA	13	Overfilling	Mechanical failure	Overfilling of tanks due to incorrect auto demin water charging - failure of level system (e.g. solenoid fail, radar fail, partial close)	Loss of up to 16,000 litres of Toxic, DTE, Very Toxic or corrosives from Process tanks but being contained within the bund. May be release of toxic vapours. If does run out of bund may leave site and go to Blackburn WWTW and ultimately river	P	2	6	1. Chemical Tanks fitted with overflows direct to bund which are positioned below the level of lip extraction to limit potential for liquid to enter LEV	1. independent high high level monitoring & alarm on chemical tanks (local / HMI audible and visual alarm and bund alarm at gate office). 2. High high level will shut down the water to the whole line 3. Audible alarm fed from Level monitoring in the bund and relayed to Gatehouse 4. Draeger gas detection and alarm 5. Timers on valves (if no high level in precicted time, shuts valve) 6. When valve opens, software checks valve is shut after a pre-determined time to reduce demand on HHL (significant delays if incorrect)	1. Bund/trenching 2. Manual isolation valves 3. Penstock to isolate outfall to WTWW	1. Level instruments on PPM 2. SOPs 3. Trained operators 4. Spill procedures and kits	2	4	M	1. Koch - Confirm alarms specified in Control Systems column are installed 2. Koch - Confirm that Bund alarm and Drager alarm shut off water to the line	0
						E	4	6					4	4	L			
CA	14	Overfilling	Mechanical failure	Burst water main above the tanks sprays into chemical tank and overflows to bund	Loss of up to 16,000 litres of Toxic, DTE, Very Toxic or corrosives from Process tanks but being contained within the bund. May be release of toxic vapours. If does run out of bund may leave site and go to Blackburn WWTW and ultimately river	P	2	6	1. Water pipework routed down aisles to limit potential. 2. Lids may prevent ingress 3. Perspex screening may deflect water away from tanks. 4. No fire sprinklers etc in the building	1. High and independent high high level monitoring & alarm on chemical tanks (local audible and visual alarm) 2. Audible alarm fed from Level monitoring in the bund. Bund alarm sends a signal to security and activates the evacuation alarm 3. Draeger gas detectors	1. Bund 2. Manual isolation valves available but significant delay as need to contact Emcor	1. Trained operators 2. Spill procedures and kits	2	4	M	1. Survey liquid lines above the tanks and consider if it is practical to provide an isolation valves which are easily accessed without need to call Emcor	0
						E	4	6					4	4	L			
CA	15	Overfilling	Mechanical failure	Burst hot water coil runs into tank and overflows	Loss of up to 16,000 litres of Toxic, DTE, Very Toxic or corrosives from Process tanks but being contained within the bund. May be release of toxic vapours	P	2	7	1. Chemical Tanks fitted with overflows direct to bund which are positioned below the level of lip extraction to limit potential for liquid to enter LEV	1. High and independent high high level monitoring & alarm on chemical tanks (local audible and visual alarm) Instruments cross check each other 2. Solenoid cut off device to inlet valves on all tanks on high level. High high level will shut down the whole line 3. Audible alarm fed from Level monitoring in the bund Bund alarm sends a signal to security and activates the	1. Bund 2. Manual isolation valves 3. More likely to leak than rupture causing a slow overfill 4. Penstock to isolate outfall to WTWW	1. Trained operators 2. Heating coil condition is part of tank inspection 3. Spill procedures and kits	2	4	M	1. Confirm if the HHL shuts off the water to the heating coil (not on P&ID)	0
						E	4	7					4	4	L			
CA	16	Loss of Containment	Catastrophic failure	Line Tanks containing up to 16,000l of process materials losing their contents to the bund	Loss of up to 16,000l DTE, Toxic, very toxic & corrosives into the bund which overtops and runs across the floor with the bulk of it contained within the bund & the building. If does run out of bund may leave site and go to Blackburn WWTW and ultimately river	P	3	6	1. Materials of construction are compatible and certified. minimium welds and certified 2. No penetrations in chemical tanks 3. Significant excess material thickness to compensate for corrosion/erosion	1. High level bund alarm relayed to gatehouse and evacuation alarm sounded Low level in tank	1. Bund/trenching 2. More likely to leak than rupture 3. All tanks designed for specific chemicals used in that tank 4. Penstock to isolate outfall to WTWW	1. Routine visual internal tank inspection 2.. Emergency Spillage Procedure 3.. All personnel building tanks are coded welders 4.. NDT of welds on build	3	3	M	1. Consider tank checks on 'good to go' sheets for leaks down outside of tank./ dry bund 2. Confirm Level sensors on PPM	0
						E	4	6					4	3	L			
CA	17	Loss of Containment	Major incident	Building collapse due to natural disaster or major incident, Aircraft crash major act of terrorism	catastophic failure of mechanical intergity of tank structure loss of multiple 16,000 litres tanks of chemistry onto concrete floor. If does run out of bund may leave site and go to Blackburn WWTW and ultimately river	P	6	2	1. Steel tanks are made from 10mm steel (only needed to be 6mm). 2. Building located in low earthquake / flood area. Airfield now closed. Not a likely terrorism target	1. Secure site & building security	1. Concrete floors 2. Penstock to isolate outfall to WTWW	1. Emergency response plan	6	1	L	No further actions identified	0
						E	4	2					4	1	L			
CA	18	Loss of Containment	Design	catastophic failure of mechanical intergity of tank structure causing over spill of bund	Spillage onto existing concrete floor. Potential operator injury Chemical damage to floor coating. If does run out of bund may leave site and go to Blackburn WWTW and ultimately river	P	2	5	1. Steel tanks are made from 10mm steel (only needed to be 6mm)	1. Bund alarms would evacuate people and notify gatehouse to respond. 2. Draeger gas detector in bund are likely to raise alarm.	1. Bunds would be expected to contain a significant proportion of the material. 2. Concrete floors 3. Floors painted with chemical resistant coating 4. Penstock to isolate outfall to WTWW	1. Spill procedures and kits 2. Trained operators 3. Plastic tanks designed and manufactured to BS EN 12573 BSEN 13067 4. Steel Tanks manufactured in line with BS EN 1993-4-2:2007(Eurocode 3) 5. Tanks routinely checked for leaks and repaired as needed. 6. Tanks have inspection schedule	2	3	L	No further actions identified	0
						E	4	5					4	3	L			
CA	19	Loss of Containment	Design	Localised failure of mechanical intergity of tank structure causing jetting (e.g. 0.5" hole)	Spillage onto existing concrete floor. Potential operator injury Chemical damage to floor coating	P	2	6	1. Tanks are made from 10mm steel (only needed to be 6mm)	1. Bund alarms would evacuate people and notify gatehouse to respond. 2. Draeger gas detector in bund are likely to raise alarm.	1. Bunds would be expected to contain a significant proportion of the material. 2. Concrete floors 3. Floors painted with chemical resistant coating	1. Spill procedures and kits 2. Trained operators 3. Plastic tanks designed and manufactured to BS EN 12573 BSEN 13067 4. Steel Tanks manufactured in line with BS EN 1993-4-2:2007(Eurocode 3) 5. Tanks routinely checked for leaks and repaired as needed. 6. Tanks have inspection schedule	2	4	M	No further actions identified	0
						E	2	6					2	4	L			
CA	20	Abnormal Chemcial Reaction	Design	Mixing of caustic and acid chemistry in a tank	Release toxic gas caused by reaction from incompatible chemicals	P	3	8	1. Safetainers have pin arrangement to prevent wrong safetainer connection	1. Bund alarms may trigger if mixing leads to overflow. 2. Draegers may alert operator to a problem. 3. HHL alarm may alert operator to a problem.	1. Tanks are fitted with lids & lip extraction so fume emission is reduced 2. Bund to contain any overflow.	1. SOPs and Trained operators 2. Clear labelling of safetainers and systems to minimise error. 3. 2 people used for Safetainer changeover - 4 eye check of correct container. 4. Veolia have procedure to confirm correct chemical for tank. 5. Emergency procedures	3	5	M	1. Implement a clear procedure for the addition of chemicals to tanks from safetainers. This should minimise the risk of the incorrect chemical being added to a tank 2. Implement a clear procedure for the bulk addition of chemicals to tanks from IBCs (Veolia). This should minimise the risk of the incorrect chemical being added to a tank and should include a clear transfer of responsibility from BAE (e.g. PTW) and suitable checks that the correct chemicals are used. 3. Review the training / authorisation arrangements for personnel involved in these transfers (Safety Critical Tasks) 4. Complete human factors review of the tank filling / safetainer changeover procedures to minimise the potential for mixing incompatible chemicals	0
						E	3	8					3	5	L			
CA	21	Abnormal Chemcial Reaction	Human error	Wrong type of metal put into an incompatible tank causing a chemical reaction	The assessment team do not anticipate a violent or significant adverse chemcial reaction - Quality affect only.	P			1. Other materials that may react with the chemicals are not present in the building							1. MEST to confirm that by placing any combination of metal component into any tank, that no violent or significant adverse chemcial reaction is expected to occur. If such a hazard is identified, the HAZID will need to be updated accordingly	0
						E												
CA	22	Loss of containment	Human error	Concentration of chemical too high	For the majority of chemicals this will only be a quality issue. For the toxic materials, additional fumes may be generated (increased concentration). For corrosive materials, the integrity of the tank may be affected over an extended period of time.	P	2	8	1. Tank materials are compatible with the chemicals at expected concentrations. The presence of higher concentrations is expected to have no significant short term affect (<24hrs) 2. Higher concentrations are not used on site and so there would need to be a failure at the supplier (e.g. wrong material in container)	1. Draeger gas detectors may pick up higher levels of vapour	1. Tanks are fitted with lids & lip extraction so fume emission is reduced 2. Bund to contain any overflow.	1. SOP and trained people including 4-eye check of chemicals 2. Incident investigation and subsequent tank inspection. 3. Routine chemical analysis by MEST etc would be expected to identify any such gross error within a very short period (<24 hrs)	2	5	M	1. Koch to confirm that tanks can take the undiluted concentration of each chemical (i.e. no water added) - Initial feedback is that >20% Nitric Acid at >20'C is detrimental to PVDF used on stages 11 & 12. 2. Koch to consider the effect of adding higher concentrations (e.g. due to wrong delivery) and to confirm that this would not be expected to lead to failure of the tanks in the short term (e.g. 24 hrs in which time it would be expected that QC testing would highlight the issue and corrective action could be taken to dilute to an acceptable level). Damage to the tank is considered acceptable in this scenario but a breach of containment would not be acceptable) 3. Consider how to record this knowledge for future use - e.g. include it in the descriptive part of the training packages / procedures) 4. Review the tank bulk filling procedure to ensure that water is always added before the chemical is added.	0
						E	2	8					2	5	L			
CA	23	Loss of containment	Instrument failure	Instrumentation fails or gives a false reading (e.g. level probe, temperature probe, pH probe)	Potential for overfill of tank, high temperature in tank, etc. These scenarios are already covered in this HAZID.	P										No further actions identified	0
						E												
CA	24	Misc	Instrument failure	Control system (PLC) fails or becomes corrupt leading to unexpected actions	Potential for overfill of tank, high temperature in tank, wrong parts in tanks, wrong sequencing etc. These scenarios are already covered in this HAZID.	P			1. PLCs will generally fail to operate if there is a problem. PLC has self check process.			1. Commissioning checks				1. Koch to confirm what diagnostics are available on the PLC to identify any issues with internal failure of the system (there are PLC start up checks but rarely restarted)	0
						E												
CA	25	Misc	Human error	Overload flight bar with large volume component exceeds fireboard and overfills	Parts are lowered into the tank which then overflows into bund. Speed is low enough that overflow would be expected to cope with flow, but worst case is overfill exiting over the top of the tank.	P	2	6	1. Tank dimensions limit the potential for oversize components 2. Possibility of a large volume component is considered very low as not present in the building.	1. Transporter may recognise overload if large volume components are added	1. Lip extraction provided (lids open when component enters the solution) 2. Plastic shielding prevent splashing etc 3. Transporter extraction (not scrubbed) 4. Bund	1. Overflow is checked as being clear as part of the tank inspection process 2. Operators may question the presence of large volume components but may also just assume the system is correct.	2	4	M	1. Koch to confirm the maximum volume figures and how close it gets to the overflow. 2. If an issue is identified with potential overflow related to component size, consider if there is a need for some type of 'volume check' as part of the software checks at the beginning of a sequence.. 3. Transporter operations to stop if HHL detected in the tank that is in use.	0
						E	1	6					1	4	L			
CA	26	Misc	Design	Chemical carry over on components between tanks	Transfer of acid/ alkali into a tank which contains the opposite material. This is a well understood issue on the site. Quantities are likely to be small due to the nature of the components being dipped.(Typically less than 1 litre, possible for upto 10 litres) . Worst case = Maximum area = 32m2 with max of 1 litre per m2 = 32 litres	P	2	9	1.Quantities are likely to be small due to the nature of the components being dipped. 2. Drip trays etc are chemical resistant	1. The processes involve rinse tanks between dissimilar chemicals which is expected to reduce any carryover.	1. Lip extraction provided (lids open when component enters the solution) 2. Plastic shielding prevent splashing etc 3. Transporter extraction (not scrubbed)	None identified	2	5	L	No further actions identified	0
						E	1	9					1	5	L			
CA	27	Misc	Other	Building fire elsewhere spreading to the line	Tanks containing chemicals which could boil dry & decompose due to the heat from the fire forming a toxic gas. Unlikley to cause an explosion as no combustible materials near by / already consumed by fire. Hazard will be obvious due to large fire meaning non emergency personnel not expected to be	P	2	6	None identified	1. Building fire alarm that activates roof & wall vents & evacuates the building	1. Smoke detection 2. Heat detectors 3. Bund will hold 4 full tanks of chemicals but would then overflow via surface water drains to Penstock on drains from site to Blackburn WWTW	1. Emergency response times of 20mins for LFRS. 2. 4 hr Out of hours patrols 3. Good housekeeping 4. On site BAE fire team audits 5. Fire risk assessments 6. Vibration monitoring	2	4	L	No further actions identified	0

					preswent. Fire water run off may be contaminated with chemicals. Potential for multiple plastic tanks to fail in short period (7 tanks are plastic with a total bund capacity of 4.4 tanks)	E	4	6				7. PAT lasting 8.Fire awareness training of staff 9. Fire fighting strategy unlikely to involve large volumes of water directly on the line to minimise FWRO	4	4	L		
CA	28	Loss of containment	Human error	Two incompatible tanks overflowing at the same	This scenario would require two simultaneous failures to occur (e.g. sabotage, PLC fail to danger on two separate tanks). Gases from the mixture would enter the building. (OR plastic tank fails and corrodes SS tank next to it)	P	4	5	g	1. PLC and instrumentation are designed to fail safe. 2. Independant high level alarms warn of overfill 3. Chemical alarm will initiate evacuation	1. Segregated bunding will allow time to respond and for evacuation before material mix 2. Penstock on site drains to prevent run off to the rivers.	1. Manual isolations available 2. Emergency procedures 3. Veolia only do one transfer at once (one controlling mind)	4	3	M	No further actions identified	0
						E	4	5					4	3	L		
CA	29	Misc	Other	DFM 4 hazards	In the first HAZID session, the properties of DFM 4 were unknown. Since the initial HAZID, it has been confirmed that DFM4 is now known as Descoprep 1002 (made up from the concentrate RW-7255). RW-7255 is an **alkline** liquid which means that it is similar to the other alkaline materials and may produce hazardous decomposition compounds. **No significant additional hazard when compared to the other alkaline materials**	P											0
						E											
CA	30	Low Temperature	Mechanical failure	Low temperature leading to crystallisation	Loss of heating leading to tank cooling to ambient temperature - **No Significant Safety Hazards Identified**	P											0
						E											
CA	31	Loss of utilities	DI Water	Loss of utilities - DI Water	No DI water = low level in tanks or not spraying or not rinsing = Quality apart from potential for increased carryover to an incompatible tank etc - See high concentration	P											0
						E											
CA	32	Loss of utilities	Air agitators	Loss of utilities - Air agitators	Loss of agitator may lead to incomplete mixing within the tank. In extreme cases, potential for pockets of higher concentration material - See high concentration	P											0
						E											
CA	33	Loss of utilities	LPHW / Steam	Loss of utilities - LPHW / Steam	Quality only **No Significant Safety Hazards Identified**	P											0
						E											
CA	34	Loss of utilities	Instrument / compressed air	Loss of utilities - Instrument / compressed air	Bubbler in safetainer would stop = quality only. Instrumentation giving false readings - See Instrumentation failure Instruments not closing as commanded by PLC etc could lead to overfill by DI water / from safetainer, leading to potential overflow of tank - See Overfill Tank lid operation may be compromised if lids are opened by pneumatic cylinders - transporter could lower into a closed tank - Mechanical damage to lids / transporter	P			1. Instrumentation, valves, etc designed to be 'fail to safe' condition'	1. Alarm on PLC HMI if air supply pressure is below target value 2. Sensors on tank lids confirm open closed and prevent transporter movement if not correct	1. Bund 2. Overflow to bund					1. Koch - Consider pros/cons of electric / air actuators on lids of tanks	0
						E											
CA	35	Loss of utilities	Electricity	Loss of utilities - Electricity	Assume total blackout. System may have tanks open but LEV scrubber goes off with potential for toxic gases to enter the building. No significant loss to the environment anticipated.	P	4	8	1. Instrumentation, valves, etc designed to be 'fail to safe' condition	1. UPS to protect any maintenance people in a tank / on transporter (move a few times). 2. UPS to protect PLC sequence to aid recovery 3. Scrubber failure (low flow alarm) and building evacuation alarm have UPS and will be triggered immediately	1. Emergency lighting 2. Bund	1. Emergency procedures	4	4	M	1. Koch - Consider pros/cons of electric / air actuators on lids of tanks	0
						E	1	8					1	4	L		
Anodise Process																	
CA	36	High Temperature	Mechanical / electrical failure	Excess Heat generated and not taken away	The excess heat will increase the temperature of the tank - See high temp scenario	P				1. Anodising current is monitored by PLC system 2. High temp sensor turns off anodising current if tank is high temperature	1. Tanks are fitted with lids & lip extraction so fume emission is reduced					1. Hock - Confirm High temp sensor turns off anodising current if tank is high temperature	0
						E											
CA	37	Misc	Mechanical / electrical failure / Human error	Anodising process acts like electrolysis and produces Hydrogen and Oxygen (normal and abnormal operation)	Anodising process acts like electrolysis and produces Hydrogen and Oxygen which reaches a concetration where ignition is possible. Explosion in head space of tank is unlikely as hydrogen rises but may lead to rupture of tank.	P	4	7	None identified	1. Anodising current is monitored by PLC system 2. Anodiser will not function when lids are open / transporter is active in the tank	1. Tanks are fitted with lids & lip extraction so fume emission is reduced 2. Transporter fitted with extraction for the short duration it is present above the tank 3. Buildings are very large and well ventilated which will aid dispersion of any evolved gases	1. Maintenance of anodising system 2. Emergency procedures	4	4	M	1. Koch - Confirm that Hydrogen levels can not reach 25% LEL levels (normal and abnormal operation). If this is possible, revisit HAZID findings	0
						E	4	7					4	4	L		
CA	38	Misc	Human Error	Current transferred to transporter / metal parts of tank	Equipment made live with potential for fatality. No harm to environment anticipated	P	3	7	1. Anodiser specialist will design and industry standard 2. Transporter support the load in two places to prevent 'swinging' of the load.	1. Any leakage current will trip system. e.g. if tank has hole, liquid onto nearby metal is enough to trip rectifier. 2. Rectifier ramps up current to check no current leakage before applying full amps. 3. All metalwork is earthed 4. Anodiser will not function when lids are open / transporter is active in the tank (PLC control)	None identified	1. Emergency stop buttons on line terminate anodising current 2. Operators trained to load and secure items to the flight bars	3	4	M	1. Koch - Confirm that Emergency stop buttons on line terminate anodising current 2. Koch - Are there any simple ways to prevent contact with the electrodes that do not compromise the quality of the process?	0
						E	0	7					0	4	L		
Extraction System																	
CA	39	Loss of Containment	Mechanical failure	Blocked tank lip extract points or scrubber failure (including power failure)	Gases into the building from ambient temp and some heated decoditiser, nitric, HF. Potential operator injury. No significant harm to environment anticipated	P	3	7	1. Lip extract gaps are large and unlikely to be clogged / blocked by buildup or corrosion.	1. Scrubber not running alarm sets fire alarm off if stopped (evacuation of the building) 2. Multiple pressure and flow sensors which also sound fire alarm 3. Draegers gas detectors	1. Roof & wall vents open on evacuation / fire alarm activation	1. Evacuation procedure 2. Local alarm activation 3. 24/7 security alarm repeat 4. Scheduled inspections of scrubber and lip extracts 5 On-site emergency team attends within 10 minutes (FCP)	3	4	M	1. Confirm that the scrubber flow alarm (or similar) has a test schedule to prove that it operates as intended. 2. Confirm scrubber flow alarm has UPS and activates evacuation in the event of power failure	0
						E	1	7					1	4	L		
CA	40	Loss of Containment	Mechanical failure	Seals on main scrubber ducting fail allowing air in and reducing suction to tank	Gases into the building from ambient temp and some heated decoditiser, nitric, HF. Potential operator injury. No significant harm to environment anticipated	P	2	6	None identified	1. Draeger gas detection	1. Roof & wall vents open on evacuation / fire alarm activation 2. Failure of seals will slow extraction rates but unlikely to lead to immediate failure before alarm sensors detect the failure	1. Evacuation procedure 2. Local alarm activation 3. 24/7 security alarm repeat 4 On-site emergency team attends within 10 minutes	2	4	M	1. Include external visual inspection of the whole of the extraction system as part of other inspections to help identify any potential leak points. (e.g. external damage, drips, discolouration)	0
						E	1	6					1	4	L		
CA	41	Loss of Containment	Design	Mixing of acidic and alkaline vapours	Incompatible materials mixing to give other hazardous substances with the duct work	P	1	9	1. The system is designed for this hazard. As the gases will be in low concentration vapour phase, violent reaction is not expected. 2. The extraction system is remote to personnel locations 3. Vapours will be extracted by the system	1. Draeger gas detection may alarm if significant vapours are produced	None identified	None identified	1	4	L	No further actions identified	0
						E	0	9					0	4	L		
CA	42	Loss of Containment	Design	Buildup of condensed vapours in scrubber pipework	Incompatible materials mixing to give other hazardous substances or buildup of a single component that may be exposed by maintenance. Small LOC within the building with limited environmental harm	P	1	9	1. The system is designed for this hazard. As the gases will be in low concentration vapour phase, violent reaction is not expected. 2. The extraction system is remote to personnel locations. 3. Materials of construction selected to be resistant to chemicals 4. Main ductwork is inside the building which will limit condensation of gases until they are outside.	1. Draeger gas detection may alarm if significant vapours are produced	None identified	1. PPE used for all pipework breakins. 2. Routine maintenance of Scrubber system as per manufacturers recommendations	1	4	L	1. Provide any low points in the ductwork with drains to safe location 2. Design ductowrk so that it has falls in appropriate directions to manage 'condensates' 3. Provide access panels in areas where buildup may be a concern to allow safe inspection / cleaning (side / top)	0
						E	1	9					1	4	L		

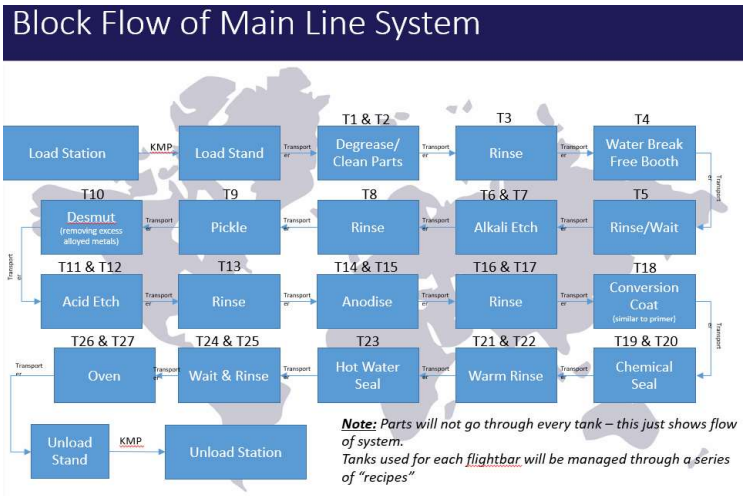
Dosing System																	
CA	43	Loss of Containment	Human error	Manual charging & movement of liquid additives to process tanks - impact damage to Safetainer (Double skinned)	Loss of up to 1000 litres of DTE, T, T+, corrosives from a plastic container causing a loss of the contents to the floor, likely to be contained within the centre of the building Potential operator exposure and injury	P	2	8	1. Safetainer is double skinned with no drain valve 2. Safetainers located within the line, away from traffic movements	None identified	1. Gulley running along the side of the line will contain the volume of a full safetainer 2. Central location within the building	1. Trained operators / FLT drivers 2. Spill kits 3. Emergency Spillage Procedure 4. Specific PPE for spillage control. 5. Safetainers have a specified lifetime before being chnaged 6. Safetainers are inspected on each fill	2	5	M	1. Consider the design of the gulley to ensure it contains 110% of a safetainer. 2. Provide a sump in the gulley to allow easy recovery of spilt material 3. Provide level alarm in the gulley sump to indicate that something is present and need attnetion (not linked to fire alarm)	0
						E	1	8					1	5	L		
CA	44	Overpressure	Substance solidifies in vent	Caustic based chemicals crystalises in vent of the air agitator located in the safetainer	Air pressurises safetainer leading to either failure of the Safetainer or the fittings. Person nearby splashed with HF while not wearing PPE. Single fatality. HF expected to be retained near incident	P	3	7	1. Safetainers are double skinned (not sealed at the top) which is expected to contain the majority of any release.	1. Air agitator pressure 3-5psi set to as low as possible and below burst pressure of safetainer. 2. Draeger gas detection	1. Gulley 2. Normally vents back into the chemical tank	1. SOPs 2. Trained operators	3	4	M	1.Consider how the vent on the safetainer (from the air agitator) could be checked / cleaned to ensure that the vent remains clear. 2. Confirm that when Safetainers are replaced, the associated pipework etc is replaced as being at end of life - 5 years (previously agreed that pipework needs to be changed but unclear if this being done). 3. Confirm the burst pressure of a safetainer	0
						E	2	7					2	4	L		
CA	45	Overpressure	Fouling or Human error	Pipe from Chemical dosing pump (e.g. small Grundfoss) blocked, resulting in over pressure in pipework from pump to tank	Rupture of pipework releasing up to 1000 litres of chemical - worst case 40% HF - potential fatality	P	3	7	1. Pipework rated to 10 barg which is above maximum pressure possible from pump 2. Pump can only deliver 30 litres per hour	1. Inbuilt flow meter stops pump if no flow	1. Bund and gulley 2. Pipes are double walled 3. All joints have spray guards 4. Draeger may detect and alarm	1. Maintenance have procedures for generating process risk assessments for access beyond guards 2. PPE for maintenance 3. Chemical & Emergency awareness training 4. Trained operators 5. Spill kits available	3	3	M	1. Consider fitting pumps within a clear protective cover / box to minimise spray in the event of failure. 2. Confirm that when Safetainers are replaced, the associated pipework etc is replaced as being at end of life - 5 years (previously agreed that pipework needs to be changed but unclear if this being done). 3. Confirm max pump pressure is less than the pressure rating of the pipework 4. Consider stopping pump after 1 hr to limit total maximum loss 5. Ensure open end of pipe into tank is above the level of the overflow to remove the potential for syphoning	0
						E	2	7					2	3	L		
CA	46	Loss of Containment	Human error	Safetainer vent not connected	Fumes from safetainer are localised at the safetainer location. May harm person working in immediate vicinity. No environmental harm	P	2	8	1. Transfers will tend to draw air into the safetainer rather than force fumes out. 2. Vent is part of the main connection process so unlikely to be left off	1. Draeger gas detectors may detect any release 2. General room ventilation may be sufficient to dilute vapours from most chemicals	None Identified	1.SOPs for connecting Safetainers 2. Trained operators 3. Safetainer locations are not near workstations	2	5	M	No further actions identified	0
						E	0	8					0	5	L		
Filtration / Circulation System																	
CA	47	Overpressure	Mechanical failure	Chemical leak from the filtration system (e.g. pump seal, filter case lid, flanges)	Pipeline rupture leading to the loss of chemical at low level onto the building floor which would be captured in the bund or it may pool & be contained within the building with little escaping through the building door and entering the SW drain	P	2	8	1. The system uses a double diaphragm pump which is unlikely to produce adequate pressure to rupture lines / fittings, but this can not be confirmed. - See actions 2. All equipment located below the top of the tank and pump is inside the tank.	1. Draeger gas detectors may detect any release 2. Bund alarms	1. All equipment located within the bund 2. Penstock on line to Blackburn WWTW 3. Spray guards as for the rest of the line	1. PPE - Full acid suit 2. Chemical & Emergency awareness training 3. Trained Operators 4. Spill kits & drain covers available for outside 5. Emergency response and HF "antidote"	2	6	M	1. Confirm if pipework is designed for pressure greateter than pump can deliver. 2. Consider providing additional splash guarding to protect operator. 3. Develop a PPM schedule for the acid addition system to include maintenance of seals to prevent leakage. 4. Provide the operator with a risk assessment and SOP.	0
						E	1	9					1	6	L		
CA	48	Low pressure / low flow	Mechanical failure	Lack of mixing / filtration e.g. Filter blocked, eductor not working effectively	Quality problems only - **No Significant Safety Hazards Identified**	P										No further actions identified	0
						E											
CA	49	Misc	Maintenance	Exposure of chemicals when the filter cartridge needs to be replaced	Operfor / Technician splashed with chemicals or residue left on floor where others may be harmed	P	2	9	None identified	1. Draeger gas detectors may detect any release 2. Bund alarms	1. Drip trays to capture any material leaking from the filter before it is 'bagged' up.	1. SOP for safe changing of filters 2. PPE assuming filter	2	6	M	1. Can filters be flushed through with water before they are removed to minimise hazard 2. Assess personal exposure during change over and consider if LEV is needed or if RPE is suitable. 3. Implement a suitable process and equipment to mange a filter change safely.	0
						E	1	9					1	6	L		
Cooling System																	
CA	50	Overfilling	Mechanical failure	Burst cooling water coil runs into tank and overflows	Loss of up to 16,000 litres of Toxic, DTE, Very Toxic or corrosives from Process tanks but being contained within the bund. May be release of toxic vapours	P	2	7	1. Chemical Tanks fitted with overflows direct to bund which are positioned below the level of tp extraction to limit potential for liquid to enter LEV	1. High and independent high high level monitoring & alarm on chemical tanks (local audible and visual alarm). 2. Instruments cross check each other 3. Solenoid cut off device to inlet valves on all tanks on high level. High high level will shut down the whole line 4. Audible alarm fed from Level monitoring in the bund	1. Bund 2. Manual isolation valves 3. More likely to leak than rupture causing a slow overfill	1. Trained operators 2. Cooling coil condition is part of tank inspection 3. Spill procedures and kits	2	4	M	1. Confirm if the HHL shuts off the water to the cooling coil (not on P&ID)	0
						E	4	7					4	4	L		
Bunding																	
CA	51	Loss of Containment Environmental impact	Design	Mixing of caustic and acid chemistry into bund	Release toxic gas caused by reaction from incompatable chemicals	P	2	8	1. Segregated bunds 2. No drain valves etc on chemical tanks	1. Bund sump level alarms trigger evacuation 2. Draegers alert operator to a problem	1. Bund	1. Emergency procedures 2.Tank inspections 3. SOPs and trained personnel for all chemical transfers	2	5	M	No further actions identified	0
						E	2	8					2	5	M		
CA	52	Loss of containment	Fire	Failure of multiple tanks leading to over-topping of the bund	See 'Fire' in Tanks Sections	P										No further actions identified	0
						E											
Transporters and Flight Bars																	
CA	53	Loss of Containment	Mechanical failure	Flightbar or component drops into solution	Chemicals over-tops the tank into bund. Splashing of chemicals. Spillage retained within building	P	2	8	1. Lids on chemical tanks would prevent incident if this was not the target tank 2. Transporter height above tanks is minimised, limiting potential for splashing. 3. Parts have low cross section area the way they are mounted, which may reduce amount of displaced material	1. Drip trays under transporter but not always closed. 2. Any significantly misaligned parts are likely to be dislodged by surrouding equipment before reaching chemical tanks (e.g. lids open). 3. Slack bell detector may help if component makes contact with other equipment	1. Tank and walkway sreening 2. Significant free board to limit amount spilled. 3. Bund 4. Transporter etc are enclosed to limit splash potential (sequencing)	1. Spill procedures and kits 2. Operators trained to load flightbar and check jig is correctly fitted. 3. Regular LOLER inspections of transporter 4. Belts are routinely replaced every 12 months due to chemical environment	2	3	L	No further actions identified	0
						E	1	8					1	3	L		
CA	54	Loss of Containment	Mechanical failure / Human Error	Lid only partially open – transporter / flight bar impact	Precursor to "flightbar or component drops into solution" above or Component falls outside tank	P				1. Lids have position sensors to confirm in correct position relealtive to the transporter							0
						E											
CA	55	Others	Human error	Contractor maintenance	Various falls & impact damage from contract maintenance duties resulting in harm to people (predominately the contractors) and the environment	P	3	7	None identified	None identified	None identified	1. Contractor Risk Assessments 2. Agreed methodologies (e.g. RAMS) 3. Method statements 4. Competance assessment (UEC) before contractors are employed by BAE 5. Permit to Work System	3	5	M	No further actions identified	0
						E	2	7					2	5	L		
CA	56	Others	Human error	Operator in gangway when items unloaded from transporter at loading station	Potential crush injury / fatality	P	3	8	1. Raising and lowering of flights bars is remote to other work stations	1. Light curtain around loading point stops movement of transporter and loading station. 2. KMP (Kuka Mobile Platform) is automated with suitable scanners etc	1. Clearly marked area 2. Audible klaxon whilst load unload station moving 3. Dead mans handle to operate station	1. SOPs 2. Trained operators 3. Light beams and other safety systems on the transported are routinely tested	3	4	M	No further actions identified	0
						E	0	8					0	4	L		
CA	57	Others	Design	Acid drips / residues on the drip tray on transporter which is then moved into an area where operators may work	Contamination of a working area by drips from drip tray. Minor injury possible .	P	1	10	None identified	None identified	1. Drip trays designed to minimise leaks. 2. When transporter is over an area, no operator can be present under a suspended load	1. Operators trained in chemical awareness 2. Gloves worn 3. Mtce team has risk assessment and Dynamic RA to avoid this hazard.	1	8	M	1. Confirm that chemical resistant gloves are worn when handling the drip trays 2. New PFD arrangements appear to work OK and these will be replicated to make sure we don't come into contact / underneath including waterbreakfree and unload / load.	0
						E	0	10					0	8	L		
CA	58	Abnormal Chemcial Reaction	Mechanical / Electrical failure	Transporter lowers compenent into the wrong tank	See 'Wrong type of metal put into an incompatible tank causing a chemical reaction' in Tank Section	P											0
						E											
Powder Additions																	
CA	59			At the time of the HA2D, no powders additions are made on the New Anodise Line		P											0
						E											

Bulk Fill - Veolia bring IBCs of chemicals, hoses, pump, trained personnel. Area is handed over to Veolia under a PTW. Courdoned off, IBCs positioned, pump and hoses connected. Hose into tanks positioned via the blister and secured in position. Water level checked as present.First IBC is transferred. Pump transferred to next IBC and repeated. When complete, system is flushed through with water into the tank. Tank is topped up to operating level with water.																				
CA	60	Abnormal Chemcial Reaction	Human error	Wrong chemcial added to the tank during bulk fill. Mixing of caustic and acid chemistry in a tank	Release toxic gas caused by reaction from incompatable chemicals (See compatibility matrix below)	P	2	8	1. Use of IBCs for bulk fill, means it is not practical to use different fittings etc.	1. Bund alarms may trigger if mixing leads to overflow. 2. Draeger gas detectors may pick up higher levels of vapour 3. HHL alarm may alert operator to a problem.	1. Bund to contain any overflow. 2. Lip extraction to minimise loss of gases 3. Lids closed during chemical additions to ensure LEV is effective. 4. Anodise bulk fill via the blister	1. Trained operators 2. Clear labelling of IBCs 3. Risk assessment, permits and method statements in place for filling which includes a check of the correct IBC / Tank. 4. Bulk fill is carried out by a competent contractor. 5. 4 eye check of crrect container. 6. PPE worn during transfers and area is courdoned off	2	6	M	1. Complete human factors review of the tank filling procedures to minimise the potential for mixing incompatible chemicals. 2. Consider if this procedure is safety critical 3. Ensure that this process is always done under a PTW, which includes a visual check by the PTW issuer that the correct chemicals and tank have been selected.	0
						E	2	8					2	6	M					
CA	61	Overpressure / Loss of Containment	Mechanical failure	Overpressure in IBC transfer system or Loss of containment from hoses , joints, seals	Loss of up to 1000 litres of DTE, T, T+, corrosives from an IBC / pump / hose causing a loss of the contents to the floor. Due to the location in the centre of the building, expect the majority to be maintained within the building (or existing trenches towards effluent) Potential operator exposure and injury. Fatality possible if sprayed with corrosives or unable to escape and exposed to toxic fumes. Limited environmental effect.	P	3	6	1. Maximum pump pressure is below the maximum pressure rating of the pipework and fittings. 2. No valves on hose after the pump 3. Pressure and flow rates are low so hose will not whip around if loose.	1. Draeger gas detectors may pick up higher levels of vapour	1. Bund / trench	1. Area is barriered off and hoses routed to avoid damage. 2. Hose is secured to prevent slippage out of the tank. 3. PPE worn during transfers 4. Trained contractors with Risk assessment, permits and method statements in place and PPE 5. Emergency procedures 6. Hoses inspected before use for condition 7. Spill kits	3	4	M		0
						E	1	6					1	4	L					
CA	62	Abnormal Chemcial Reaction	Human error	Concentrated acids etc added to tank during bulk fill with no water already in tank. Then water added leading to violent reaction.	Heat of 'dilution' leads to steam generation and creation of fumes which could harm people near by. No environmental hazard	P	2	8	None identified	1. Draeger gas detectors may pick up higher levels of vapour	1. Lip extraction to minimise loss of gases 2. Lids closed during chemical additions to ensure LEV is effective	1. Area is barriered off. 2. PPE worn during transfers 3. Trained contractors with Risk assessment, permits and method statements in place and PPE 4. Emergency procedures	2	5	M	1. Ensure that SOP includes a visual check by two personnel that the water has been added prior to the chemicals (this is likely to require contact with an operator and confirmation via the HMI)	0
						E	0	8					0	5	L					
Bulk Empty - Veolia bring vacuum tanker, hoses, trained personnel, etc. Hose lowered into tank from transporter and connected to fixed waste line with external connection point to vacuum tanker. All connection points are confirmed as 'valve closed, blank/plug fitted'. Line is washed through with water to ensure no other chemicals present and no leaks from the other connection points. Hose manually positioned to remove as much liquid as possible Tank is jet washed multiple times to dilute remaining chemicals and sucked to tanker. Tanker has capacity for a full tank plus washings . Lines washed through with water before hoses disconnected																				
CA	63	Low pressure	Human error	Operator (Veolia) closes valves in suction line form vacuum tanker used to empty tanks OR Inadequate vacuum from tanker / pipe run too long	Suction applied from road tanker to downstream hose, collapses hose (and empties it). **No Significant Safety Hazards Identified**	P			1. Pressure calcs indicate 3" line has suitable pressure drop to ensure vac is effective at the furthest tank.							No further actions identified	0
						E														
CA	64	Loss of containment	Human error	Valve left open elsewhere on the line waste line. Water line connected - check all connections. Flush from tank. Tested at tanker. Reverse flow. NRV in line. Tanker SI/C	Chemical from tank will leak / flow from the opening. Exposure of operators to pool of chemical. Spillage inside building likely to be spotted by operators relatively quickly. Potential to syphon if opening occurs after priming	P	2	8	If there is a large opening in the waste pipe before the vacuum is applied (e.g. valve open), it is likely that the line from the tank will prime - therefore no chemical hazard. If the opening is small, it is likely to draw air into the line, minimising any exit of chemical	1. Draeger gas detectors may pick up higher levels of vapour	1. Waste pipe and valves at each tank are located within the bund	1. SOP requires all valves to be confirmed as closed and capped. Water is then flushed through and the line re-inspected for leaks before applying vacuum. 2. PPE worn during transfers 3. Trained contractors with Risk assessment, permits and method statements in place and PPE 4. Emergency procedures	2	5	L	1. Review SOP to include the necessary checks and flush sequence. 2. Koch to supply outlet caps	0
						E	1	8					1	5	L					
CA	65	Loss of containment	Mechanical failure	Hose / coupling fails during a transfer. (e.g. hose not connected properly, impact damage, hose leaks)	Chemical continues to syphon from tank / drain from vac tanker until hose is removed from tank, tank waste connection valve is closed, vac tanker valve closed. Pool of chemical forms outside building (no spray etc). Fumes / corrosive burns to personnel. Potential for chemicals to enter drains and into river	P	2	8	None identified	None identified	1. Gulley / Trench will help to contain leaks that occur inside the building. 2. Connection point is in the external chemical delivery area	1. Vac tanker operator can see the hose connection point and is present during the transfer. 2. Method statements requires line connections to be checked prior to starting transfers 3. Hoses inspected prior to use 4. Hoses run in areas where impact is not expected (e.g. vehicles excluded)	2	6	M	1. Ensure all components in the waste line are compatible with the worst case chemicals and any substances created by interaction of chemicals	0
						E	4	8					4	6	M					
CA	66	Cross contamination	Design	Residue left in line after transfer which may be incompatible with next transfer.	Chemical fills pipe upstream of the tank connection point and not washed out, two tanks emptied at same time. Chemical reaction within pipe leading to LOC.	P	2	8	1. New Anodise Line waste pipe is not connected to the New PFD waste pipe	None identified	1. Bund will contain leaks that occur inside the building.	1. Method statemntrequires that water is flushed through the line before and after each transfer 2. PPE worn during transfers 3. Trained contractors with Risk assessment, permits and method statements in place and PPE 4. Emergency procedures	2	5	M	No further actions identified	0
						E	1	8					1	5	L					

Total Scenarios:	66
Last Scenario Reference:	CA66
Total Number of Actions:	70
Last Action Reference:	CA65.1

Category	Residual Risk Summary	
	Risk to People	Risk to the Environment
High		
Medium (if ALARP)	34	3
Low	9	34
Not Applicable	21	21
Total		

ADDITIONAL INFORMATION



Process Steps

- 8 recipes overall
- only 6 will happen at any given time

Tank Chart

Number	Process	Chemistry	Concentration (g/l)	Working Volume (m^3)	Tank Material	Temperature (°C)	Heat Up Load (kW)	Steady State Load (kW)	Evaporation (kg/s)	Cooling (kW)	Air Agitation Volume (m^3/s)	Eductor Agitation TO's/h
1	Load											
2	Alkaline Clean	Turco	40-60	16.64	304 SS	45-60	78.4	33.4	0.0302	-	0.0247	-
3	DI Rinse	Water	<20uS	15.25	304 SS	<35	-	-	-	-	0.0302	-
4	WBF Inspection											
5	DI Rinse	Water	<20uS	15.25	304 SS	<35	-	-	-	-	0.0302	-
6	Alumin Etch	Airbus Etch	35-45 NaOH & 10 Sodium glucohepatonate	16.64	304 SS	30-40	38.6	13.5	0.00857	-	0.0329	-
7	Alumin Etch	Airbus Etch	35-45 NaOH & 10 Sodium glucohepatonate	16.64	304 SS	30-40	38.6	13.5	0.00857	-	0.0329	-
8	DI Rinse	Water	<20uS	15.25	304 SS	<35	-	-	-	-	0.0302	-
9	Pickle	Surtec 181	5%v/v	16.64	316 SS	40-60	78.4	33.4	0.0302	-	0.0329	-
10	Desmut	Nitric	450-550	16.64	PP	10-25	9.3	5.5	0.00857	-	0.0329	-
11	TI Etch/Pickle	HF&Nitric	300-450 HNO_3 20-24 HF	16.64	PVDF	15-26	11.4	5.8	0.00282	-	0.0329	-
12	TI Etch/Pickle	HF&Nitric	300-450 HNO_3 20-24 HF	16.64	PVDF	15-26	11.4	5.8	0.00282	-	0.0329	-
13	DI Rinse	Water	<20uS	15.25	PVDF	<35	-	-	-	-	0.0302	-
14	TFSAA	H_2SO_4	4-5%wt	18.71	PP	24-27	15.43	N/A	0.00345	42.3	0.0555	-
15	TFSAA	H_2SO_4	Proprietary	18.71	PP	24-27	15.43	N/A	0.00345	42.3	0.0555	-
16	DI Rinse	Water	<20uS	15.25	316 SS	Ambient	-	-	-	-	0.0302	-
17	DI Rinse	Water	<20uS	15.25	316 SS	Ambient	-	-	-	-	0.0302	-
18	TI Conversion Ct	Fluoride Phosphate	50 Na_2PO_4 & 20 KF// 9 NaF & 8.2HF	16.64	PVDF	21-33	25.5	10.0	0.00638	-	0.0329	-
19	Seal	Surtec 650V	8-12% (assumed wt)	16.64	316 SS	30-40	38.7	11.8	0.00857	-	-	3
20	Seal	Surtec 650V	8-12% (assumed wt)	16.64	316 SS	30-40	38.7	11.8	0.00857	-	-	3
21	Warm DI Rinse	Water	<20uS	16.64	316 SS	32-38	34.8	9.0	0.00131	-	-	3
22	Warm DI Rinse	Water	<20uS	16.64	316 SS	32-38	34.8	9.0	0.00131	-	-	3
23	Hot Water Seal	Water or Dichromate	-	16.64	316 SS	88-93	138.5	90.0	0.0605	-	0.0329	3
24	Hot Water Seal	Wait (Water)	-	15.25	316 SS	N/A	-	-	-		0.0302	-
25	DI Rinse	Water	<20uS	15.25	304 SS	Ambient	-	-	-	-	0.0302	-
26	Drying Oven											
27	Drying Oven											
28	Unload											

The Tank Chart shows us what the chemistry and process requires are per station
Chiller load has been updated, tank 23 no need for force chilling
On cascaded rinses, conductivity target will be achieved on second stage

BAE SYSTEMS

Tank Summary Table

Number	Process	Heating	Cooling	Drain to effluent	Air Agitation	Eductor Agitation	Top Spray	Cascade	Filtration	Conductivity Control	pH Monitor	DI Water Supply	Cathode Rails & Plates	Chemical Quick Fill	Chemical Dosing	Safetainer (number)	Air Agitation Safetainer	Blip/ Blisters	Specified Liner	Overflow
1	Load																			
2	Alkaline Clean	✓			✓							✓		✓	✓	✓✓	✓	✓		✓
3	DI Rinse			✓	✓		✓			✓		✓						✓		✓
4	WBF Inspection			✓								✓								
5	DI Rinse			✓	✓		✓			✓		✓						✓		✓
6	Alumin Etch	✓			✓							✓		✓	✓	✓	✓	✓		✓
7	Alumin Etch	✓			✓							✓		✓	✓	✓		✓		✓
8	DI Rinse			✓	✓		✓			✓		✓						✓		✓
9	Pickle	✓			✓				✓			✓		✓	✓	✓	✓	✓		✓
10	Desmut	✓			✓							✓		✓	✓	✓✓		✓		✓
11	TI Etch/Pickle	✓			✓							✓		✓	✓	✓		✓	PVDF	✓
12	TI Etch/Pickle	✓			✓							✓		✓	✓	✓		✓	PVDF	✓
13	DI Rinse			✓	✓		✓			✓		✓						✓		✓
14	TFSAA	✓	✓		✓	✓			✓			✓	✓	✓	✓	✓		✓		✓
15	TFSAA	✓	✓		✓	✓			✓			✓	✓	✓	✓	✓		✓		✓
16	DI Rinse			✓	✓		✓			✓		✓						✓		✓
17	DI Rinse			✓	✓					✓	✓	✓						✓		
18	TI Conversion Ct	✓			✓							✓		✓	✓	✓✓✓		✓	PVDF	✓
19	Seal	✓				✓			✓		✓	✓		✓	✓	✓		✓		✓
20	Seal	✓				✓			✓		✓	✓		✓	✓	✓		✓		✓
21	Warm DI Rinse	✓		✓						✓		✓						✓		✓
22	Warm DI Rinse	✓		✓						✓		✓						✓		
23	Hot Water Seal	✓	Towns	✓	✓	✓				✓	✓	✓			✓	✓ +		✓		✓
24	DI Rinse			✓	✓		✓			✓		✓						✓		✓
25	DI Rinse			✓	✓				✓	✓		✓						✓		
26	Drying Oven	✓																		
27	Drying Oven	✓																		
28	Unload																			

To be switched off when processing | On different heating circuit | Recirc? Or eductor? | Changed this issue

Stage 23 is force cooled using Towns Water
Stage 24 will be configured as a wait station with air agitation provision, no educators

CHEMICAL DETAILS / INCOMPATABILITY

Process	Tank	Chemical	Turco 4215	Surtec 061/089	Airbus Etch	Bonderite Alum Etch #2	Surtec 181	DFM4	Nitric Acid	Ardrox 295 GD	HF/Nitric	Sulphuric acid	Fluoride phosphate	SurTec 650V	Socosurf TCS	Socosurf PACS/Hydrogen peroxide mix	SDS files			
Alkaline Clean	2	Turco 4215						?	x	x	x	x	x				Bonderite C-AK 4215 NCLT Aero	Eye damage, fertility, aquatic	Reacts with acids	Powder, slighty alkaline
		Surtec 061/089						?	x	x	x	x	x				MSDS SurTec 061	skin eyes	Reacts with acids	Liquid, slighty alkaline
																	MSDS SurTec 089	Eye damage, aquatic, do not swallow	-	Liquid, slighty alkaline
Aluminium Etch	6,7	Airbus Etch*						?	x	x	x	x	x				sodium-hydroxide	skin eyes **corrosive**	Strong oxidising agents. Acids. Metals. Water. Alcohols.	Powder, alkaline
		Bonderite Alum Etch #2						?	x	x	x	x	x				Bonderite C-AK Alum Etch Aero 2	skin eyes **corrosive**	Acids. Water.	Powder, alkaline
Aluminium Pickle	9	Surtec 181						?	x	x	x	x	x				MSDS SurTec 181	skin eyes **corrosive**	Acids. Reacts with base metals as aluminium.	liquid, alkaline
		DFM4**	?	?	?	?	?		?	?	?	?	?	?	?	?	not available			
Desmut	10	Nitric Acid	x		x	x	x	?									nitric acid	skin eyes **corrosive**	Reducing agents, Bases, Keep away from combustible material. Protect from contamination. Galvanised metals, Brass	liquid, acidic
		Ardrox 295 GD	x		x	x	x	?									Ardrox 295 GD sds v1 z2l	skin eyes **corrosive**	Strong reducing agents,	liquid, acidic
Titanium Etch	11, 12	HF/Nitric			x	x	x	?									HF Nitric	skin eyes **Toxic**	strong bases , metals	liquid, acidic
TFSA	14,15	Sulphuric acid	x		x	x	x	?									Sulphuric acid	skin eyes	Organic materials, Bases, Reducing agents, Metals	liquid, acidic
Ti Conversion coating	18	Fluoride phosphate (mix of tribasic sodium phosphate, HF and Potassium Fluoride) ***			x	x	x	?	x	x	x	x				x	tribasic sodium phosphate,	skin eyes lungs	Strong oxidising agents. Strong acids.	Solid alkaline
																	potassium Fluoride,	skin eyes **Toxic**	**Contact with strong acids liberates hydrogen fluoride.**	Powder, slighty alkaline
																	HF acid	skin eyes **FATAL**	Metals, Oxidizing agents, Bases, ammonia, **sulphuric acid**	liquid, acidic
Anodise seal	19,20	SurTec 650V						?	x	x	x	x	x				SDS_SurTec 650 V_502200_502202_GB_EN	Aquatic	**Contact with strong acids releases hydrogen fluoride.**	liquid, acidic
		Socosurf TCS						?									socosurf_tcs_SDS_english-CLP-EUR	Eyes	-	liquid, acidic
HW Seal/PACS	23	Socosurf PACS/Hydrogen peroxide mix****			x	x	x	?									socosurf_pacs_SDS_english-CLP-EUR,	-	-	liquid, acidic
																	hydrogen-peroxide-technical--wt-solution-in-water-stabilised-across-organicstrade	skin eyes lungs, Oxidiser (35%)	Excess heat. Combustible material. Metals. copper. Finely powdered metals. Reducing Agent. Strong bases. Combustible material. Strong reducing agents.	liquid, acidic

Primary chemical

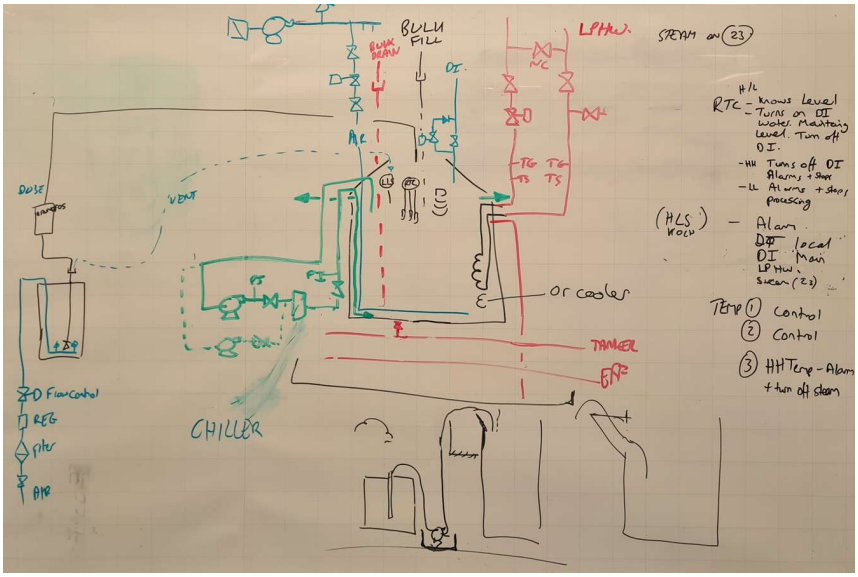
x ot compatible

* these are not proprietary chemicals . Therefore generic SDS sourced from Fisher for Sodium Hydroxide

** material under development, no SDS available yet

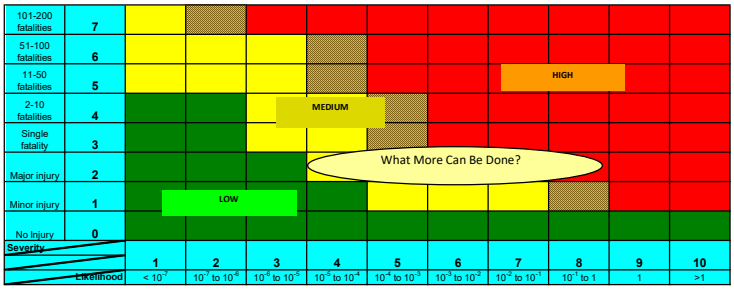
***These are not proprietary chemicals . Therefore generic SDS sourced from Fisher for individual components. If Brenntag are going to supply this as a ready made solution, they should be able to supply SDS for the mixture

****generic SDS for hydrogen peroxide sourced from Fisher



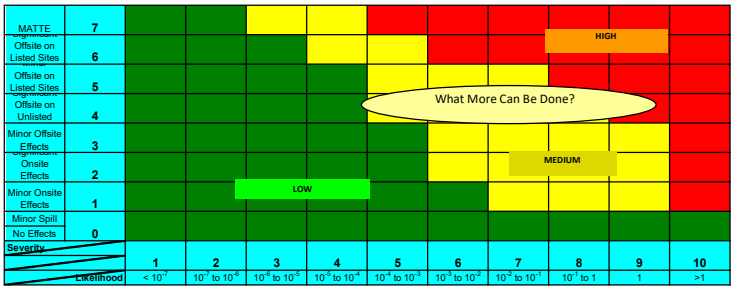
Risk Matrices

PEOPLE RISK MATRIX



Legend		
	HIGH	Further action essential to reduce the risks to an acceptable level within an agreed upon and specified time.
	MEDIUM	Further action should be considered to reduce the risks as opportunities are recognised. Must be confident that the
	LOW	No mitigation required but further action may be considered to reduce the risks.
	HIGH Boundary (Offsite Risk)	Further action essential to reduce the risks to an acceptable level within an agreed upon and specified time.

ENVIRONMENT RISK MATRIX



Legend		
	HIGH	Further action essential to reduce the risks to an acceptable level within an agreed upon and specified time.
	MEDIUM	Further action should be considered to reduce the risks as opportunities are recognised. Must be confident that the
	LOW	No mitigation required but further action may be considered to reduce the risks.