SAFETY DATA SHEET

1. IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

Product Name	**HYDROGEN FLUORIDE (ANHYDROUS)**
REACH Registration No.	01-2119458860-33-0001
Manufacturer	Mexichem UK Limited The Heath Business & Technical Park Runcorn Cheshire WA7 4QX United Kingdom Tel: +44(0) 1928 514840 E-Mail: info@mexichem.com
Emergency Phone No.	IN AN EMERGENCY DIAL 999 (UK Only) For specialist advice in an emergency telephone +44(0) 1928 572000
Use	Subject to Member State regulations, applicable uses are: An intermediate chemical product : chemical manufacture, process chemical for nuclear fuels ; catalyst in alkylation reactions (including in the petrochemical industry)

2. HAZARDS IDENTIFICATION

Very toxic by inhalation, in contact with skin and if swallowed.
Causes severe burns.
It is rapidly absorbed into the body causing rapid and drastic calcium depletion of tissues and serum, by binding it to the fluoride. This will result in acute and severe systemic effects.
Fluid build up on the lung (pulmonary oedema) may occur up to 48 hours after exposure and could prove fatal.
Immediate treatment is essential.

2.1 Classification of the substance or mixture

Directive 67/548/EEC & Directive 1999/45/EC	VERY TOXIC and CORROSIVE
Regulation (EC) No. 1272/2008 (CLP).	Acute Tox. 1 : H310: Fatal in contact with skin. Acute Tox. 2 : H300: Fatal if swallowed. Acute Tox. 2 : H330: Fatal if inhaled. Skin Corr. 1A : H314: Causes severe skin burns and eye damage.

2.2 Label elements

EC Directive 67/548/EEC:

Risk Phrases	R26/27/28 Very toxic by inhalation, in contact with skin and if swallowed. R35 Causes severe burns.

Safety Phrases	S7/9 Keep container tightly closed and in a well ventilated place. S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S36/37/39 Wear suitable protective clothing, gloves and eye/face protection. S45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
According to Regulation (EC) No. 1272/2008 (CLP).	
Hazard statement(s)	H310: Fatal in contact with skin. H314: Causes severe skin burns and eye damage. H300: Fatal if swallowed. H330: Fatal if inhaled.
Signal word(s)	DANGER
Hazard pictogram(s)	

GHS05 GHS06

Precautionary statement(s)	P280: Wear protective gloves/protective clothing/eye protection/face protection. P284: Wear respiratory protection. P262: Do not get in eyes, on skin, or on clothing. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. P310: Immediately call a POISON CENTER or doctor/physician.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Alternative names	Hydrofluoric acid (anhydrous) HF AHF

HAZARDOUS INGREDIENT(S)

Hazardous ingredient(s)	%(w/w)	CAS No.	EC No.	Hazard symbol(s) and hazard statement(s)
Hydrogen fluoride	100	007664-39-3	231-634-8	GHS05, GHS06; H310, H314, H300, H330

4. FIRST AID MEASURES

OBTAIN IMMEDIATE MEDICAL ATTENTION.
SPEED IS ESSENTIAL.
It is important that anyone attempting the rescue of an affected person should wear the appropriate respiratory protection and protective clothing. The following first aid measures can be undertaken before medical help arrives.

Most important symptoms and effects, both acute and delayed	Causes severe burns to skin, eyes, respiratory system and gastrointestinal tract. It is rapidly absorbed into the body causing rapid and drastic calcium depletion of tissues and serum, by binding it to the fluoride. This will result in acute and severe systemic effects. Fluid build up on the lung (pulmonary oedema) may occur up to 48 hours after exposure and could prove fatal.
Indication of any immediate medical attention and special treatment needed	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash skin with copious amounts of water. Skin should be washed for 1 minute, then apply calcium gluconate gel (2.5%) and massage into the burnt area, continuing with repeated applications until 15 minutes after the pain in the burnt area has subsided. This may take several hours. If there is a delay in obtaining calcium gluconate gel continue to wash skin with water until it is available. Refer to hospital where no occupational health treatment is available.
Description of first aid measures	
Inhalation	Remove patient from exposure, keep warm and at rest. Apply artificial respiration if breathing has ceased or shows signs of failing. In the event of cardiac arrest apply external cardiac massage. Oxygen may be beneficial if breathing is laboured or patient is cyanotic.
Skin Contact	Remove contaminated clothing. Wash skin with copious amounts of water. Skin should be washed for 1 minute, then apply calcium gluconate gel (2.5%) and massage into the burnt area, continuing with repeated applications until 15 minutes after the pain in the burnt area has subsided. This may take several hours. If there is a delay in obtaining calcium gluconate gel continue to wash skin with water until it is available. Refer to hospital where no occupational health treatment is available.
Eye Contact	Irrigate with eyewash solution or clean water until pain is relieved. Refer to hospital.
Ingestion	Do not induce vomiting. Provided the patient is conscious, wash out mouth with water and give 200-300ml (half a pint) of milk or water to drink. Refer to hospital.
Further Medical Treatment	SYSTEMIC EFFECTS Hydrogen fluoride is readily absorbed into the body through inhalation, skin burns and ingestion, and may cause severe systemic effects due to fluoride binding with cations, in particular calcium and magnesium, causing hypocalcaemia and hypomagnesaemia and a secondary hyperkalaemia. Hypocalcaemia and hyperkalaemia can be rapid and result in serious or fatal cardiac and neuromuscular problems. The degree of the systemic complications is directly related to the amount of circulating fluoride which is determined by the severity of exposure. As a guideline, systemic effects are likely if the skin burns (full thickness) are greater than 1% of body area (eg larger than the palm of the hand) and in all cases of significant inhalation and ingestion. General supportive measures may be required and in particular one should closely monitor the ECG and levels of electrolytes (particularly calcium and potassium). If intravenous infusion of calcium is necessary this should be continued until the serum calcium level stabilises within the normal range. Electrolyte determinations should be carried out frequently, ie once every half hour in severe cases. Calcium should be administered by the intravenous route, as absorption from the digestive tract is too slow to be of any value. The calcium salt of choice is calcium gluconate. 10% calcium gluconate solution should be given slowly intravenously. Care should be taken to avoid leaking from the vein into the surrounding

tissues as this will result in necrosis.

In the case of significant inhalation exposure there may be additional respiratory problems, in particular, bronchospasm and laryngeal and pulmonary oedema. The onset of pulmonary oedema may be delayed and it is recommended that patients be kept under observation for at least 48 hours.

SKIN BURNS
If the burn fails to respond to calcium gluconate gel, injection of a 5% solution of calcium gluconate around and under the burnt area should be considered. Some experts suggest upto 0.5ml per sq cm of skin and no more than 0.5ml in a digit. It should be noted that only 5% calcium gluconate should be used. Relief of pain is an indication that sufficient solution has been injected. A local anaesthetic should therefore not be given unless absolutely necessary.

Debridement or excision of necrotic coagulum should be considered, particularly if the coagulum is large, since it may act as a barrier to the effective penetration of the calcium gluconate gel, and so prevent the neutralisation of fluoride. For this reason an extensive necrotic coagulum may cause the patient to be refractory to treatment.

Severe subungual burns may require removal of the finger nail so that topical treatment, and if necessary local injection of 5% calcium gluconate solution, can be given.

General anaesthesia requires careful consideration because of the potential for respiratory and cardiac complications.
Calcium gluconate gel can be used as a dressing but should not be continued for longer than 24 hours. Pain may recur later after initial relief and the patient should return for further treatment. It should be noted that the onset of pain from burns caused by dilute acid or vapour may occur some hours after exposure.
Otherwise treatment is symptomatic and supportive.

EYES

The eyes should be irrigated with isotonic saline or water until pain is relieved.

Calcium salt solutions are irritating to the eye. Some experts believe that following irrigation one or two drops of sterile 10% calcium gluconate solution may be instilled or 500mls of a 1% solution of calcium gluconate in saline can be used to irrigate the eyes. These treatments should only be administered under expert supervision, otherwise treatment is symptomatic and supportive.

5. FIRE-FIGHTING MEASURES

General	Non-flammable.
Special hazards arising from the substance or mixture	May react with metals in the presence of water, to produce hydrogen which can form explosive mixtures with air.
Extinguishing media	Water spray should be used to cool containers. Use water to knock down escaping vapour. Do not apply water spray directly onto liquid pools of anhydrous hydrogen fluoride, as this will cause heat evolution and excessive fuming.
Advice for fire-fighters	A self contained breathing apparatus and full protective clothing must be worn in fire conditions.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	Keep upwind. Warn people downwind. Ensure suitable personal protection (including respiratory protection) during removal of spillages.
Environmental precautions	Spillages or uncontrolled discharges into watercourses must be IMMEDIATELY alerted to the Environment Agency or other appropriate regulatory body.
Methods and materials for containment and cleaning up	CONSULT AN EXPERT Small spillages: Dilute carefully with copious amounts of water (50 fold dilution is recommended to minimise fume emission and heat generation). Diluted spillages should be neutralised by use of soda ash, lime or lime slurry followed by water washing. Large spillages: Use water to knock down escaping vapour. Do not apply water spray directly onto liquid pools of anhydrous hydrogen fluoride, as this will cause heat evolution and excessive fuming. Apply water spray downwind of spillage or on a run off. Diluted spillages should be neutralised by use of soda ash, lime or lime slurry followed by water washing. After neutralisation with soda ash further treatment of the toxic, soluble sodium fluoride residues may be required before disposal.
Reference to other sections	See Section: 8, 13

7. HANDLING AND STORAGE

Precautions for safe handling	Avoid contact with skin and eyes. Do not breathe vapour. Use only in well ventilated areas. Atmospheric levels should be controlled in compliance with the occupational exposure limit.
Conditions for safe storage, including any incompatibilities	Keep in a cool, well ventilated place. Keep away from heat and sources of ignition. Keep away from moisture. Containers should be vented periodically to a suitable scrubbing system to prevent a dangerous build up of pressure. Vessels should be pressure vessels designed to withstand the vapour pressure of hydrogen fluoride at 47.5 Deg C, as well as sub-atmospheric pressure which can occur if hydrogen fluoride cools below 19.5 Deg C. Unsuitable containers: glass , ceramic , cast iron
Storage Temperature	Keep at a temperature not exceeding (°C): 45
Specific use	Subject to Member State regulations, applicable uses are: An intermediate chemical product : chemical manufacture, process chemical for nuclear fuels ; catalyst in alkylation reactions (including in the petrochemical industry)

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Appropriate engineering controls	Use in closed systems. The use of engineering controls to prevent leakage of HF is normal procedure. Local exhaust ventilation is used to minimise exposure to hydrogen fluoride. Atmospheric concentrations should be minimised and kept as low as reasonably practicable below the occupational exposure limit.
Personal protection equipment	Wear suitable protective clothing, gloves, eye/face protection. Butyl or PVC / Nitrile gloves and goggles are the minimum protection. For operations where there is a risk of exposure to HF, full protective clothing must be worn: Neoprene suit with double envelope leg to cover acid resistant wellington boots, gloves secured to the suit with air feed hood or filtered air hood. For emergency situations a gas tight, chemical resistant suit with self contained breathing apparatus must be worn.

Respirators

Chemical protection suit.

Eye Protection

Gloves

Environmental Exposure Controls	Environmental exposure and consequent secondary human exposure to HF must be minimised or eliminated. This is achieved in practice by the treatment of waste water containing the substance prior to discharge to WWTP using chemical conversion of HF to the insoluble calcium fluoride and subsequent disposal of the precipitated calcium fluoride. This treatment process therefore minimises the amount of HF released in effluent water. Release of gaseous HF is reduced by the use of scrubbers.

Occupational exposure limits

Occupational Exposure Limits	CAS No.	LTEL (8 hr TWA ppm)	LTEL 8 hr TWA mg/m³	STEL (ppm)	STEL mg/m³	Note:
Hydrogen Fluoride (as F)	007664-39-3	1.8	1.5	3	2.5	WEL

PNECs and DNELs

DNEL	Oral	Inhalation	Dermal
Industry - Long Term - Local effects	Not applicable.	1.5 mg/m³	Not applicable.
Industry - Long Term - Systemic effects	Not applicable.	1.5 mg/m³	Not applicable.
Industry - Short term - Local effects	Not applicable.	2.5 mg/m³	Not applicable.
Industry - Short term - Systemic effects	Not applicable.	2.5 mg/m³	Not applicable.
General public - Long Term - Local effects	-	1.25 mg/m³	-
General public - Long Term - Systemic effects	0.01 mg/kg/day	0.03 mg/m³	-
General public - Short term - Local effects	-	1.25 mg/m³	-
General public - Short term - Systemic effects	0.01 mg/kg/day	0.03 mg/m³	-

Note:
DNEL values for the general public are of limited relevance, as exposure to HF is not predicted. Hydrogen fluoride will react rapidly in the environment to form fluoride and hydronium ions and will further interact with other ionic species naturally present in the environment. Exposure to fluoride may occur following the inhalation of air; however this is likely to be negligible. The deposition of HF onto soil or vegetation may also contribute to the total fluoride intake of the general public; however the contribution of HF (from industrial sources) to the total fluoride intake is very small in comparison to the contribution of fluoride from natural sources.

Environment	PNEC
Aquatic Compartment (including sediment)	0.9 mg/l Fresh water 0.9 mg/l Marine water 0.9 mg/l Intermittent releases 0.766 mg/kg Sediment
Terrestrial Compartment	11 mg/l Soil
Atmospheric Compartment	-
Sewage Treatment Plant	51 mg/l

Note:
Separate PNECs for marine waters and intermittent releases are not derived. The Fresh water PNEC is judged to be adequately protective.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form	gas or fuming liquid below its boiling point
Colour.	colourless liquid / white vapour
Odour	pungent / irritating
Solubility (Water)	very soluble with evolution of heat
Solubility (Other)	very soluble in: ethanol
Boiling Point (° C)	19.5
Melting Point (° C)	-84
Vapour density (Air=1)	2.4 at 20 ° C
Vapour pressure (mmHg)	780 at 20 ° C
Specific Gravity	0.98 at 10 ° C
Explosive Properties	Not explosive.
Oxidising Properties	Not oxidising

10. STABILITY AND REACTIVITY

Chemical stability	Stable at ambient temperatures in closed containers, but hygroscopic on exposure in the atmosphere.
Possibility of hazardous reactions	Exothermic reaction with water or aqueous solutions, often violent, forming hydrofluoric acid. May react with metals in the presence of water, to produce hydrogen which can form explosive mixtures with air. Reacts violently with alkalis, amines, potassium permangante, lime.
Conditions to avoid	Avoid high temperatures.
Incompatible materials	Attacks glass, concrete, natural rubber, leather, many organic materials and certain metals, especially those containing silica, for example cast iron.
Hazardous Decomposition Product(s)	Not applicable

11. TOXICOLOGICAL INFORMATION

Acute toxicity / Ingestion	Very toxic if swallowed. Adverse effects similar to inhalation will occur. Will cause severe corrosion of and damage to the gastrointestinal tract. Severe irritation to the respiratory tract will also occur.
Inhalation / Acute toxicity	Very toxic by inhalation. It is rapidly absorbed into the body causing rapid and drastic calcium depletion of tissues and serum, by binding it to the fluoride. This will result in acute and severe systemic effects. LC50 (rat) (1 hr) 1307 - 2340 ppm
Acute toxicity / Skin Contact	Very toxic in contact with skin. Adverse effects similar to inhalation will occur.
skin corrosion/irritation	May cause severe burns with permanent skin damage which are slow to heal.
Serious eye damage/irritation	Risk of serious damage to eyes. May cause severe burns which could lead to permanent damage or total loss of vision.
Respiratory irritation	Vapour is severely irritant to the eyes and respiratory tract. High atmospheric concentrations may lead to bronchitis. Fluid build up on the lung (pulmonary oedema) may occur up to 48 hours after exposure and could prove fatal.

Sensitisation	Not sensitising
Repeated dose toxicity	Repeated exposure by inhalation to levels well above the occupational exposure limit may produce adverse effects on the bones (fluorosis). This may also occur following the ingestion of small amounts.
Mutagenicity	There is no evidence of mutagenic potential.
Carcinogenicity	No studies with HF are available. High quality NTP studies in the rat and mouse are available for sodium fluoride. The EU RAR has reviewed all available data for HF and NaF and concludes that the data are sufficient to suggest that fluoride is not carcinogenic in animals.
Reproductive toxicity	No studies with HF are available. However a number of studies of various designs are available with the read-across substance NaF, including high quality studies performed by the US NTP and FDA. These studies do not indicate any developmental toxicity or reproductive toxicity of fluoride.
Specific target organ toxicity — single exposure	Not classified
Specific target organ toxicity — repeated exposure	Not classified
Aspiration hazard	Not applicable.

12. ECOLOGICAL INFORMATION

Environmental Fate and Distribution	High tonnage material produced in wholly contained systems. High tonnage material used in wholly contained systems. Liquid with low boiling point.
Toxicity	Toxic to aquatic organisms. LC50 (trout) (96 hour) 51 mg/l (F-) EC50 (96 hour) (freshwater invertebrates) 26 mg/l (F-) EC50 (96 hour) (marine water invertebrates) 10.5 mg/l (F-) NOEC (21 days) (Daphnia magna) 8.9 mg/l (F-) EC50 (algae) (96 hours) 43 mg/l (F-) Long Term NOEC (soil macro-organisms) 1200 mg/kg (F-) NOEC (terrestrial plants) 0.2 - 7.5 mg/m^3 Long Term NOEC (soil micro-organisms) 106 mg/kg (F-) Bacteria: Activated sludge respiration inhibition test NOEC = 510mg/l. LD50 Birds 17 - 50 mg/kg (F-)
Effect on Effluent Treatment	Waste water containing HF is treated by onsite waste water treatment plants. All effluent is neutralised and the fluoride ions precipitated as insoluble calcium fluoride, which is subsequently disposed of. Therefore, exposure of off-site biological treatment processes to HF is unlikely.
Bioaccumulative potential	Fluoride biomagnification in the aquatic environment is of little significance. Fluoride accumulates in aquatic organisms predominantly in the exoskeleton of crustacea and in the skeleton of fish; there is no accumulation in edible tissues. In the terrestrial environment, fluoride accumulates in the skeleton of vertebrates and invertebrates, with a moderate degree of biomagnification. Vertebrate species store most of the fluoride in the bones and (to a lesser extent) the teeth; elevated levels of fluoride in the bones and teeth have been shown in animals from polluted areas.
Mobility in soil	Fluoride strongly adsorbs to soil and is essentially immobile with very low levels of leaching.
Results of PBT and vPvB assessment	Not classified as PBT or vPvB.

13. DISPOSAL CONSIDERATIONS

Regulatory Information	Disposal should be in accordance with local, state or national legislation.
Waste treatment methods	Waste water containing HF is treated by onsite waste water treatment plants. All effluent is neutralised and the fluoride ions precipitated as calcium fluoride, which is subsequently dispsosed of. Any gases released from industrial processes are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process. Residues from small spillages are neutralised soda ash, lime or lime slurry followed by water washing. PAM residues from larger spillages are neutralised with soda ash, and further treatment of the resultant soluble, toxic sodium fluoride residues may be required before disposal.

14. TRANSPORT INFORMATION

Hazard Label

Hazard Label Subsidiary 1

Road/Rail	
UN No.	1052
ADR/RID Class	8
Subsidiary 1 Hazard Class	6.1
Packing Group	I
ADR/RID Proper Shipping Name	HYDROGEN FLUORIDE, ANHYDROUS
SEA	
IMDG Class	8
Subsidiary 1 Hazard Class	6.1
UN Packing group Sea	I
Marine Pollutant	Not classified as a Marine Pollutant
AIR	
Note:	Forbidden for transport by air.

15. REGULATORY INFORMATION

Chemical Safety Assessment (CSA)	A Chemical Safety Assessment has been completed for this substance.
UK Control Regulations	Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended) and COSHH essentials: Easy steps to control chemicals - Control of Substances Hazardous to Health Regulations HSG193 (2nd edition 2003).

16. OTHER INFORMATION

This data sheet was prepared in accordance with Regulation (EC) No. 1907/2006.

Information in this publication is believed to be accurate and is given in good faith, but it is for the User to satisfy itself of the suitability for its own particular purpose. Accordingly, Mexichem UK Limited gives no warranty as to the fitness of the Product for any particular purpose and any implied warranty or condition (statutory or otherwise) is excluded except to the extent that such exclusion is prevented by law. Freedom under Patent, Copyright and Designs cannot be assumed.
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Glossary

WEL: Workplace Exposure Limit (UK HSE EH40)
COM: The company aims to control exposure in its workplace to this limit
TLV: The company aims to control exposure in its workplace to the ACGIH limit
TLV-C: The company aims to control exposure in its workplace to the ACGIH Ceiling limit
MAK: The company aims to control exposure in its workplace to the German limit
Sk: Can be absorbed through skin
Sen: Capable of causing respiratory sensitisation
Bmgv: Biological monitoring guidance value (UK HSE EH40)

Risk Phrases

R26/27/28 Very toxic by inhalation, in contact with skin and if swallowed.
R35 Causes severe burns.

Hazard statement(s)

H300: Fatal if swallowed.
H310: Fatal in contact with skin.
H314: Causes severe skin burns and eye damage.
H330: Fatal if inhaled.

The following sections contain revisions or new statements: 1

Annex to the extended Safety Data Sheet (eSDS)

Exposure Scenario	Risk management measures (RMM) Containment and local exhaust ventilation	Risk management measures (RMM) Personal protection equipment	Risk management measures related to the environment
ES 0 Manufacture of HF	The manufacture of hydrogen fluoride is contained within a closed system. The use of engineering controls to prevent leakage of HF is normal procedure. Leak detection is in place. Local exhaust ventilation is required during transfer of the substance into containers.	Operators or maintenance technicians carrying out intrusive work should wear full chemical suit and breathing apparatus.	All hydrogen fluoride produced will be funnelled through pipes and collected as a gas. In general, manufacturing sites quote 0 kg/d as the release to water as all water is treated by neutralisation followed by precipitation of fluoride as insoluble calcium fluoride. Exhaust gases are absorbed in wet scrubbers. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.
ES 1 Use as an intermediate, including for nuclear fuel processing	In modern plants the transfer from barrel to reactor will be automated and enclosed. Therefore contact with hydrogen fluoride will be minimal. However, in some instances, local exhaust ventilation is required during transfer of the substance into the reactors.	Some activities require manual handling in which case precautions will be taken to limit potential contact and the use of personal protective equipment/clothing is required. All workers are informed of the hazards of HF and receive adequate training in the prevention of exposure by the use of appropriate engineering controls and personal protective equipment/clothing.	Loss of the substance to waste water is not likely as hydrogen fluoride will be transferred to a closed vessel where it will be entirely consumed in the reaction. All effluent is neutralised at the on-site treatment plant. Addition of lime causes precipitation of fluoride as insoluble calcium fluoride. Exhaust gases are absorbed in wet scrubbers. Scrubber residues may be sent to external waste treatment, on-site effluent treatment.
ES 2 Use as a catalyst in alkylation reactions, including in the petrochemical industry	The use of hydrogen fluoride as a catalyst in alkylation reactions is contained within a closed system. The use of engineering controls to prevent leakage of HF is normal procedure. Local exhaust ventilation is required during transfer of the substance into the reactors. Although, in modern plants the transfer from barrel to reactor will be automated and possibly enclosed.	Some activities require manual handling in which case precautions will be taken to limit potential contact and the use of personal protective equipment/clothing is required. All workers are informed of the hazards of HF and receive adequate training in the prevention of exposure by the use of appropriate engineering controls and personal protective equipment/clothing.	Loss of the substance to waste water is not likely as all effluent is neutralised at the on-site treatment plant. Addition of lime causes precipitation of fluoride as insoluble calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.
ES 3 Laboratory Use	Used in a contained manner. In educational institute laboratories, hydrogen fluoride will be used in a fume hood which is equivalent to LEV. In industrial laboratories either a fume hood or full respiratory protection is used.	Acid protective suit, gloves, goggles, face shield and filtered air supply. In educational institutes, dilute HF is used. PPE includes the use of heavy duty gloves, goggles, lab coat and fume hood. Workers potentially exposed to HF are informed of the hazards and are trained in the use of appropriate engineering controls and protective equipment/clothing required to minimise exposure to the substance.	In educational institutes, hydrogen fluoride is neutralised and disposed of in the solvent waste. The solvent waste is sent for incineration at a special dedicated site. At production and end-use sites, the hydrogen fluoride tested in the laboratories is treated by the onsite waste water treatment plant. All effluent is neutralised and the fluoride ions precipitated as calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment or on-site effluent treatment.

ES 4 Mining, enrichment, purification of minerals, metals and materials	Due to the hazardous nature of HF, dipping/immersing processes are performed by automated systems in contained vessels with little or no potential for exposure to operators. LEV will be used in all situations where potential exposure could occur.	Some activities require manual handling in which case precautions will be taken to limit potential contact and the use of protective clothing is required. A face mask will be used if exposed to an open vessel of hydrofluoric acid. All workers are informed of the hazards of HF and receive adequate training in the prevention of exposure by the use of appropriate engineering controls and personal protective equipment/clothing.	Loss of the substance to waste water is not likely as all effluent is neutralised at the on-site treatment plant. Addition of lime causes precipitation of fluoride as insoluble calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.
ES 5 Passivation of metal surface	The use of hydrogen fluoride in the passivation of a metal surface is contained within a closed system. The use of engineering controls to prevent leakage of HF is normal procedure. Local exhaust ventilation is required during transfer of the substance into the reactors. Although, in modern plants the transfer from barrel to reactor will be automated and possibly enclosed.	Some activities require manual handling in which case precautions will be taken to limit potential contact and the use of personal protective equipment/clothing is required. All workers are informed of the hazards of HF and receive adequate training in the prevention of exposure by the use of appropriate engineering controls and personal protective equipment/clothing.	Loss of the substance to waste water is not likely as all effluent is neutralised at the on-site treatment plant. Addition of lime causes precipitation of fluoride as insoluble calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.
ES 6 Construction industry	The use of engineering controls to prevent leakage of HF is normal procedure. Local exhaust ventilation is used to minimise exposure to hydrogen fluoride.	Precautions will be taken to limit potential contact and the use of protective equipment/clothing is required. Workers potentially exposed to HF are fully informed of the associated hazards and are provided with and adequately trained in the use of appropriate protective equipment.	Waste water is treated by the onsite waste water treatment plant. All effluent is neutralised and the fluoride ions precipitated as calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.
ES 7 Formulation and preparation of diluted HF	Predominantly in a contained manner. The use of engineering controls to prevent leakage of HF is normal procedure. Local exhaust ventilation is used to minimise inhalation exposure.	Precautions will be taken to limit potential contact and the use of protective equipment/clothing is required. Workers potentially exposed to HF are fully informed of the associated hazards and are provided with and adequately trained in the use of appropriate protective equipment.	All hydrofluoric acid should be contained within the preparation formed. Waste water treatment involves neutralisation followed by precipitation as calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.
ES 8 Industrial cleaning of drums and pipelines	Predominantly in a contained manner. The use of engineering controls to prevent leakage of HF is normal procedure. Enclosed process equipment with local exhaust ventilation.	Precautions will be taken to limit potential contact and the use of protective clothing is required. Workers are informed and aware of the risks and are trained in the use of the appropriate Risk Management Measures (engineering controls and Personal Protective Equipment).	All dilute hydrofluoric acid used in the cleaning of drums and pipelines is subjected to waste water treatment after use. Waste water treatment involves neutralisation, followed by precipitation as calcium fluoride. Minimum loss as gas is expected the substance is used in solution form. Where scrubbers are used, residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.

ES 9 Solar industry	Predominantly in a contained manner. The use of engineering controls to prevent leakage of HF is normal procedure. Local exhaust ventilation is used to minimise inhalation exposure.	Precautions will be taken to limit potential contact and the use of protective equipment/clothing is required. Workers potentially exposed to HF are fully informed of the associated hazards and are provided with and adequately trained in the use of appropriate protective equipment.	Waste water is treated by the onsite waste water treatment plant. All effluent is neutralised and the fluoride ions precipitated as calcium fluoride. Any gases released from the process are passed through gas scrubbers to remove any HF in the air. Minimal release is expected as a highly diluted aqueous solution is used. Scrubber residues may be sent to external waste treatment, on-site effluent treatment or recycled back into the process.