Attachment 5.7.2 Site Specific Risk Analysis of Potential Interactions between Chemical Systems and Radioactive Material (Page 1 of 8)

Credible Scenarios Involving Chemicals that Could Result in a Radiological Release

Scenario Number	Cause	Description
1	**Piping Break**	In this scenario, the broken chemical piping could allow the chemical to spill onto another material with which it is not compatible. The chemical reaction could result in the release of radioactive material.
2	**Fire/Excessive Heat**	In this scenario, the fire or excessive heat would increase the chance of a chemical reaction. Materials that were once suitable for the application are no longer suitable because of the increased heat. This would allow a reaction to occur and could cause piping material to fail. This could allow the chemical to come into contact with incompatible materials, possibly resulting in the release of radioactive material.
3	**Instrument Failure**	In this scenario, the instrumentation fails and allows the chemicals to overflow out of their storage tanks, or the process tank. Having the chemicals overflow could allow the chemicals to come into contact with incompatible materials. Again, this could possibly result the chemicals overflow could allow the chemicals to come into contact with incompatible materials. Again, this could possibly result in the release of radioactive material.

Attachment 5.7.2 Site Specific Risk Analysis of Potential Interactions between Chemical Systems & Radioactive Material (Page 2 of 8)

Possible Interactions and Reactions

DNR	Does Not React	**SR**	Slight Reaction Possible
NC	No Contact	**R**	Reaction Possible

Possible Affected Components

			Waste Water Tanks	De-Gassing Tanks	Restoration Pumps	Injection/ Production Pumps	Fresh Eluant Tanks	Permeate Tank	Precip Tanks*	RO Circuit Piping	Elution Piping	Waste Water Piping	Precip Piping [1]	Production Piping
		Construction Material [2]												
Scenario	**Chemical**	Component / Chemical System Piping												
			Fiber-glass	*PVC*	*Carbon Steel*	*Carbon Steel*	*Fiber-glass*	*Fiber-glass*	*Fiber-glass*	*PVC/ Carbon Steel*	*PE/ Carbon Steel*	*PE/ Stainless Steel*	*PE/ Carbon Steel*	*PE/ Carbon Steel*
Line Break	50% H_2O_2	Stainless Steel	NC	SR	R	R	DNR	DNR	DNR	SR/R	DNR/R	DNR/R	DNR/R	DNR/R
	Soda Ash	PVC	NC	NC	DNR	DNR	DNR	DNR	NC	DNR	DNR	DNR	NC	NC
	NaCl	PVC	DNR	DNR	SR	NC	DNR	DNR	NC	DNR/SR	DNR/SR	DNR/SR	NC	NC
	NaOH	PVC	DNR	DNR	SR	NC	DNR	DNR	DNR	DNR/SR	DNR/SR	DNR/SR	DNR/SR	DNR/SR
	37 % HCl	PVC	DNR	DNR	R	R	DNR	DNR	DNR	DNR/R	DNR/R	DNR/R	DNR/R	DNR/R
	Bicarbonate	PVC	NC	NC	SR	SR	NC	NC	NC	NC	NC	DNR/SR	NC	DNR/SR
Excessive Heat/Fire	50% H_2O_2	Stainless Steel	NC	R	R	R	R	R	R	R	R	R	R	R
	Soda Ash	PVC	NC	NC	DNR	DNR	SR	SR	NC	SR	SR	SR	SR	NC
	NaCl	PVC	DNR	SR	SR	NC	DNR	DNR	NC	SR	SR	SR	NC	NC
	NaOH	PVC	SR	SR	SR	NC	SR	SR	SR	SR	SR	SR	SR	SR
	37 % HCl	PVC	R	R	R	R	R	R	R	R	R	R	R	R
	Bicarbonate	PVC	NC	NC	SR	SR	NC	NC	NC	NC	NC	R	NC	R
Instrument Failure	50% H_2O_2	Stainless Steel	NC	NC	NC	NC	NC	NC	DNR	NC	NC	NC	DNR/R	NC
	Soda Ash	PVC	NC	NC	NC	NC	DNR	NC	NC	NC	DNR	NC	NC	NC
	NaCl	PVC	NC	NC	NC	NC	DNR	NC	NC	NC	DNR	NC	NC	NC
	NaOH	PVC	NC	NC	NC	NC	NC	NC	DNR	NC	NC	NC	DNR/SR	NC
	37 % HCl	PVC	NC	NC	NC	NC	NC	NC	DNR	NC	NC	NC	DNR/R	NC
	Bicarbonate	PVC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

[1] Precip = Precipitation.

[2] Construction materials are preliminary.

Pipe/Line Break

Likelihood of Occurrence	1	2	3	4	5	6
A						
B						
C			H_2O_2 HCl			
D	Soda Ash Bicarb	NaCl NaOH				
E						
F						

Severity of Consequence

Legend/Key

Likelihood of Occurrence:

A: Event has more than a 90% chance of occurrence.
B: Event has between 70% and 90% chance of occurrence.
C: Event has between 50% and 70% chance of occurrence.
D: Event has between 30% and 50% chance of occurrence.
E: Event has between 10% and 30% chance of occurrence.
F: Event has less than a 10% chance of occurrence.

Severity of Consequence:

1: Event will result in no release of radioactive materials.
2: Event could release small amounts of radioactive material; exposures would have little or no change.
3: Event could release moderate amounts of radioactive material; exposures would be elevated but still considerably less than the regulatory limits.
4: Event could release large amounts of radioactive material; exposures could be approaching regulatory limits.
5: Event could release large amounts of radioactive material; exposures could exceed regulatory limits.
6: Event will result in a release of radioactive materials; exposure limits would be exceeded.

High Risk	Countermeasures will need to be taken.
Moderate Risk	Countermeasures will need to be considered.
Low Risk	No countermeasures will need to be taken.

Analysis of Risks (Pipe/LineBreak):

Chemical	
H_2O_2	Hydrogen peroxide can be corrosive to both PVC and carbon steel. The piping material selected for use in the peroxide circuit will be non-reactive with the chemical. The flow for the peroxide service will be low (< 20 gallons per minute) and will be intermittent use. In order for peroxide to cause a release of radioactive material, it would have to leak/drip on the same section of pipe or tank undetected for an extended period of time in order to compromise the integrity of the other materials. The radioactive materials that peroxide could come in to contact with are injection fluid, production fluid, fresh eluate, RO permeate, RO concentrate, precipitation fluid, and waste water. All of these radioactive materials are in liquid form and would not cause exposures to exceed regulatory limits. With the selection of the proper peroxide piping material and the process control devices put in place, the risk associated with peroxide can be reduced (from cell C3 to cell D3 in the risk chart) and no other countermeasures would need to be taken.
HCl	Hydrochloric acid can be corrosive to carbon steel. The piping material selected for use in the acid circuit will be non-reactive with the chemical. The flow for the acid circuit will be low (< 20 gallons per minute) and will be intermittent use. In order for acid to cause a release of radioactive material, it would have to leak/drip on the same section of pipe or tank undetected for an extended period of time in order to compromise the integrity of the other materials. The radioactive materials that the acid could come into contact with are injection fluid, production fluid, fresh eluate, RO permeate, RO concentrate, precipitation fluid, and waste water. All of these radioactive materials are in liquid form and would not cause exposures to exceed regulatory limits. With the selection of the proper acid piping material and the process control devices put in place, the risk associated wtih the acid can be reduced (from cell C3 to cell D3 in the risk chart) and no other countermeasures will need to be taken.

Excessive Heat/Fire

Likelihood of Occurrence	1	2	3	4	5	6
A						
B						
C						
D						
E						
F		Soda Ash NaCl	NaOH	Bicarb	H_2O_2 HCl	

Severity of Consequence

Legend/Key

Likelihood of Occurrence:

A: Event has more than a 90% chance of occurrence.
B: Event has between 70% and 90% chance of occurrence.
C: Event has between 50% and 70% chance of occurrence.
D: Event has between 30% and 50% chance of occurrence.
E: Event has between 10% and 30% chance of occurrence.
F: Event has less than a 10% chance of occurrence.

Severity of Consequence:

1: Event will result in no release of radioactive materials.
2: Event could release small amounts of radioactive material; exposures would have little or no change.
3: Event could release moderate amounts of radioactive material; exposures would be elevated but still considerably less than the regulatory limits.
4: Event could release large amounts of radioactive material; exposures could be approaching regulatory limits.
5: Event could release large amounts of radioactive material; exposures could exceed regulatory limits.
6: Event will result in a release of radioactive materials; exposure limits would be exceeded.

High Risk	Countermeasures will need to be taken.
Moderate Risk	Countermeasures will need to be considered.
Low Risk	No countermeasures will need to be tak

Analysis of Risks (Fire):

Chemical	
Bicarb	Bicarbonate - with excessive heat (above 120 F), there is an increased chance of a chemical reaction with carbon steel and polyethylene materials. In the plant, there is less than a 10% chance that a fire would be able to continue for a long period of time because the materials in the plant are non-combustible (concrete, steel, and fiberglass). No countermeasures are required.
H_2O_2	Hydrogen peroxide - with excessive heat (above 120 F), there is an increased chance of a chemical reaction with carbon steel, PVC, fiberglass, and polyethylene materials. In the plant, there is less than a 10% chance that a fire would be able to continue for a long period of time because the materials in the plant are non-combustible (concrete, steel, and fiberglass). No countermeasures are required.
HCl	Hydrochloric acid - with excessive heat (above 120 F), there is an increased chance of a chemical reaction with carbon steel, PVC, fiberglass, and polyethylene materials. In the plant, there is less than a 10% chance that a fire would be able to continue for a long period of time because the materials in the plant are non-combustible (concrete, steel, and fiberglass). No countermeasures are required.

Instrument Failure

Likelihood of Occurrence	1	2	3	4	5	6
A						
B	Soda Ash NaCl Bicarb	NaOH	H_2O_2 HCl			
C						
D						
E						
F						

Severity of Consequence

Legend/Key

Likelihood of Occurrence:

A: Event has more than a 90% chance of occurrence.
B: Event has between 70% and 90% chance of occurrence.
C: Event has between 50% and 70% chance of occurrence.
D: Event has between 30% and 50% chance of occurrence.
E: Event has between 10% and 30% chance of occurrence.
F: Event has less than a 10% chance of occurrence.

Severity of Consequence:

1: Event will result in no release of radioactive materials.
2: Event could release small amounts of radioactive material; exposures would have little or no change.
3: Event could release moderate amounts of radioactive material; exposures would be elevated but still considerably less than the regulatory limits.
4: Event could release large amounts of radioactive material; exposures could be approaching regulatory limits.
5: Event could release large amounts of radioactive material; exposures could exceed regulatory limits.
6: Event will result in a release of radioactive materials; exposure limits would be exceeded.

High Risk	Countermeasures will need to be taken.
Moderate Risk	Countermeasures will need to be considered.
Low Risk	No countermeasures will need to be taken.

Analysis of Risks (Instrument Failure):

Chemical

All	It is likely that instrumentation will fail at some point. However, there will be redundant instrumentation on the chemical systems at the tank (i.e. level and flow) as well as at the destination point (i.e. level and pH). It is highly unlikely that all of the instrumentation would fail at once. Therefore, the likelihood of occurrence can be moved from the "B" level down to the "F" level in the risk chart. No further countermeasures are required.