Florence Copper Project
Chemicals to be Stored On-Site

Curis provides little detail regarding the types of chemicals it plans to use at the Florence Copper Project. In many cases, Curis states that it will make final decisions regarding the mining solution and SX/EW chemicals to be used *after* the required permits are issued. It is clear from the application and the nature of the mining and extraction processes to be used that the following chemicals will be used and stored on site:

- Sulfuric acid.
- Diluting agents, such as kerosene.
- Copper extraction agents, such as alcohols.
- Cobalt sulfate, an acidic cobalt salt and form of sulfuric acid.
- Acid mist suppressants, typically a fluorocarbon chemical.
- Neutralizing agents for the wastewater treatment plant, such as lime and sodium hydroxide.
- Unleaded gasoline.
- Diesel fuel.
- Unspecified packaged dry chemicals.
- Clay, sand and concrete.
- Drilling mud.
- Preganant Leach Solution.
- Raffinate.
- Hydraulic Control Solution.

Many of these chemicals are considered hazardous substances. Additional information on these chemicals and how and where they will be stored is provided below.

Chemicals in Aboveground Storage Tanks.

Curis will store many liquid chemical products in Aboveground Storage Tanks (ASTs) throughout the project site. Curis's application is not clear regarding how many Aboveground Storage Tanks (ASTs) will be located in multiple tank farms around the site, nor does Curis indicate how many tank farms there will be. It appears that the main tank farm will be located in the northwest area of the site, just west of the underground mine works. Other tanks farms will be located within individual mining units throughout the area to be mined. The ASTs in these tank farms will store solutions for distribution through the pipeline network to wells, processing facilities, and impoundments.[1]

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[1] Curis APP Amendment Application, Attachment 9 (Design Documents), at 10-11.

Many of the ASTs will store various acidic mining solutions, including:

- Pregnant Leach Solution (PLS) from recovery wells that does not contain enough copper to process in the SX/EW plant. More acid will be added to the PLS in the ASTs and the PLS will then be reinjected into the aquifer.[2]
- High-copper PLS destined for storage in the PLS impoundment before processing.[3]
- Hydraulic Control Solution (HCS) from perimeter wells that will be treated in the water treatment facility.[4]
- Raffinate from the Raffinate pond. Acid will be added to the Raffinate in the ASTs before it is reinjected into the aquifer.[5]
- Sulfuric acid.

SX/EW Plant Area

Within the SX/EW plant area, numerous chemicals will be stored in a warehouse and in ASTs, including the following:

- Diluents, used to dilute the mining solution for processing, typically a petroleum-based chemical such as kerosene.
- Extractants, such as alcohols, used to separate copper from solutions.
- Cobalt Sulfate, a toxic acidic salt and form of sulfuric acid used in the electrowinning process.
- Fluorocarbon Mist Suppressant[6]

The actual contents of these process chemicals is not known. Curis proposes to disclose the contents of its SX/EW process chemicals after the permit is issued.[7]

Other unspecified packaged dry chemicals, clay, drilling mud, sand, concrete and other chemicals will be stored in a warehouse, apparently in the SX/EW area.[8]

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[2] Curis APP Amendment Application, Attachment 9 (Design Documents), at 10.

[3] *Id.*

[4] *Id.*

[5] *Id.*

[6] *Id.* at 12.

[7] Curis UIC Application, *Review of Existing and Proposed Requirements of UIC Permit No. AZ3900001*, Part II(E)(4)(e).

[8] Curis APP Amendment Application, Attachment 9 (Design Documents), at 15.

Wastewater Treatment Plant

The wastewater treatment plant appears to be designed mainly for pH neutralization, although Curis states that the "specific treatment processes . . . will depend somewhat on the results of pilot-scale tests . . . ." Neutralization of mining waste waters will require storage of large quantities of neutralizing agents, such as lime and sodium hydroxide.[9]

Curis provides additional detail regarding some of the mining process chemicals and solutions. A summary of this information is provided below.

Sulfuric Acid

Tanker trucks or train cars will deliver 93% sulfuric acid, a hazardous material, to one or more ASTs in the SX/EW area. The main acid storage area, however, will be ASTs located within the in situ tank farm in the mining area. It is not clear from the review to date how acid will be transferred from the SX/EW area to the in situ tank farm, although it likely will be piped.[10]

- Curis estimates in its design documents that it will require 3.45 pounds of acid to extract one pound of copper during commercial operations.[11] In its cost estimates, Curis projects that it will use 2,467 kilotonnes—over 5.4 billion pounds—of acid over twenty years of mining.[12] At the height of mining activity in Year 11, Curis projects it will need over 400 million pounds of acid in a single year — over 1 million pounds per day.[13]

- All of this acid will have to be transported to the Curis site, although Curis has provided no details about how this will be done. But as an example, a railroad tank car containing hazardous materials is limited to a capacity of 34,500 gallons or 263,000 pounds, whichever is less.[14] At the height of

[9] Curis APP Amendment Application, Attachment 9 (Design Documents), at 12.

[10] Curis APP Amendment Application, Attachment 9 (Design Documents), at 11.

[11] Curis Application, Attachment 2, *Design Flow Calculations*, Exhibit 2A, *Letter from Thomas L. Drielick, P.E.* (January 24, 2011). SRK Consulting, a Curis consultant, reports that the in-situ leach process will require 5 pounds of sulfuric acid to produce one pound of copper. It is not clear why the discrepancy exists between the two reports. SRK Consulting, *Preliminary Economic Assessment for the Florence Project, Pinal County, Arizona*, at 7 (September 30, 2010).

[12] One kilotonne equals 2,204,620 pounds.

[13] SRK Consulting, *Preliminary Economic Assessment for the Florence Project, Pinal County, Arizona*, Exhibit 19-1 (September 30, 2010) (Attachment 1).

[14] 49 C.F.R. § 179.13.

copper production in Year 11, therefore, Curis would have to receive 1,520 rail tankers of sulfuric acid—the equivalent of 4 tanker cars per day.[15]

- The sulfuric acid, which is often produced as a byproduct of mine smelters, is projected to contain antimony, arsenic, cadmium, lead mercury and other contaminants.[16] The exact contents are unknown, however, because Curis proposes to provide that information to ADEQ and USEPA *after* the permit is issued and before pilot testing begins. Curis provides no reason why it cannot provide the information as part of the permit application.[17]

Pre-Stacked Pregnant Leach Solution

Pregnant Leach Solution from recovery wells with low copper concentrations will be reinjected into the aquifer, after more acid is added to the solution. Pre-stacked PLS will be stored in ASTs for the addition of acid, then piped back to the injection well field. Curis provided estimates of chemical concentrations in the pre-stacked PLS in units applicable to solids.[18] Absent information regarding the density of raffinate, it is impossible to compare Curis's projections to water quality standards or background groundwater concentrations.

Raffinate

Raffinate, or "barren PLS," is PLS that has been processed in the SX/EW plant to remove copper. Raffinate will be piped to the 2.4 acre raffinate impoundment pond for temporary storage, then piped to aboveground distribution tanks at or near mining areas. Acid will be added to the raffinate in the tanks for reinjection into the aquifer. The raffinate impoundment pond will have a 5.3 million gallon capacity. The size of the aboveground storage tanks in mining areas is not disclosed by Curis in the application materials. [19]

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[15] It appears sulfuric acid would have to arrive by train because Curis has projected that it will require only 12 tractor-trailer trucks per day to supply the mine. Curis's acid needs alone would require 8,000 tanker trucks in Year 11, based on the 1994 average tanker truck weight of about 50,000 pounds per payload. Department of Transportation, *Comprehensive Truck Size and Weight Study*, at III-9, Table III-4 (August 31, 2000).

[16] Curis APP Amendment Application, Attachment 10 (Characterization of Discharge), Exhibit 10A, Table 3-1.

[17] Curis UIC Application, *Review of Existing and Proposed Requirements of UIC Permit No. AZ3900001*, Part II(E)(4)(e).

[18] Curis APP Amendment Application, Attachment 10 (Characterization of Discharge), Exhibit 10A, Table 3-1.

[19] Curis UIC Application, Glossary, at xiii; UIC Application, Attachment K (Injection Procedures), at 8; APP Amendment Application, Attachment 9 (Design Documents), at 11 and 13.

Although raffinate is a liquid solution, Curis provided estimates of chemical concentrations in the raffinate in units applicable to solids.[20] Absent information regarding the density of raffinate, it is impossible to compare Curis's projections to water quality standards or background groundwater concentrations.

SX/EW Strip Solution

Curis indicates that some of the SX/EW strip solution may be reinjected into the aquifer with the Raffinate.[21] This strip solution is projected to contain antimony, arsenic, cadmium, chromium, lead, mercury, nickel and selenium at concentrations above Arizona Water Quality Standards.[22]

Fuels

Unleaded and diesel fuels will be stored in ASTs, although it is not clear where the ASTs will be located.[23]

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[20] Curis APP Amendment Application, Attachment 10 (Characterization of Discharge), Exhibit 10A, Table 3-1.

[21] Curis APP Amendment Application, Attachment 10 (Characterization of Discharge) at 10.

[22] Curis APP Amendment Application, Attachment 10 (Characterization of Discharge), Exhibit 10A, Table 3-1.

[23] Curis APP Amendment Application, Attachment 9 (Design Documents), at 15-16.

Attachment 1

COMPANY	Curis Resources			Operating Expenses																											
BUSINESS UNIT	Florence ISCR																														
OPERATION	80,000k-lbs Cu/yr			PREPRODUCTION			START																END PRODUCTION		POST PRODUCTION						CLOSURE
	value / factor	units / sensit.	Total or Avg.	-3 2010	-2 2011	-1 2012	1 2013	2 2014	3 2015	4 2016	5 2017	6 2018	7 2019	8 2020	9 2021	10 2022	11 2023	12 2024	13 2025	14 2026	15 2027	16 2028	17 2029	18 2030	19 2031	20 2032	21 2033	22 2034	23 2035	24 2036	25 2037
Cu PRODUCTION																															
Cathode Produced	-	klb-Cu	1,175,011			0	68,175	77,648	70,826	84,859	74,302	73,824	80,637	73,571	73,565	80,646	84,787	77,276	80,430	70,709	45,410	28,615	17,609	9,767	2,354	0	0	0	0	0	0
Additional Cathode	-	klb-Cu	61,137			0	1,165	1,327	1,327	2,572	3,460	3,460	6,137	6,994	7,630	6,790	6,480	7,851	2,401	1,438	1,232	747	125	0	0	0	0	0	0	0	0
Total Cu Recovered		**klb-Cu**	**1,236,149**	**0**	**0**	**0**	**69,340**	**78,975**	**72,153**	**87,430**	**77,762**	**77,285**	**86,775**	**80,566**	**81,195**	**87,436**	**91,267**	**85,127**	**82,831**	**72,147**	**46,643**	**29,362**	**17,734**	**9,767**	**2,354**	**0**	**0**	**0**	**0**	**0**	**0**
Production Summary																															
Flow to SX		gpm	-			0	8,250	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	0	0	0	0	0	0
PLS Cu		g/l	-			0.00	1.89	1.61	1.47	1.76	1.54	1.53	1.67	1.53	1.53	1.67	1.76	1.60	1.67	1.47	0.94	0.59	0.37	0.20	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Bleed to Pond		gpm	-			0	260	385	510	702	755	832	712	634	634	496	577	604	602	613	623	634	655	657	659	661	664	666	0	0	0
Reclamation bleed		gpm	-			0	0	0	0	0	0	0	304	366	365	364	364	363	356	349	342	355	368	380	393	413	433	452	0	0	0
Total bleed to pond		gpm	-			0	260	385	510	702	755	832	1,016	1,000	999	861	941	967	958	962	965	989	1,023	1,038	1,052	1,074	1,096	1,118	0	0	0
Bleed to pond		klb-Cu	-			0	172	218	263	433	408	447	417	339	339	291	356	339	352	315	206	132	84	47	11	0	0	0	0	0	0
OPERATING COST																															
Operating Cost Summary																															
Production	-	**$000s**	**525,327**	0	0	4,386	22,280	25,306	25,057	29,304	28,025	29,247	32,801	30,700	30,515	32,550	33,616	34,590	33,367	31,052	23,811	19,535	16,382	13,847	11,392	8,883	3,220	1,971	1,617	1,274	601
SX-EW	-	**$000s**	**264,482**	0	0	970	12,796	14,626	13,915	15,507	14,791	14,742	15,731	15,084	15,149	15,800	16,199	15,559	15,320	14,206	11,548	9,747	8,536	7,705	6,933	2,224	2,224	1,974	1,375	1,155	666
G&A	-	**$000s**	**50,219**	0	0	1,828	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,090	2,008	2,008	1,716	1,716	1,279	1,122	917
OPERATING COST	-	**$000s**	**840,027**	**0**	**0**	**7,184**	**37,166**	**42,023**	**41,063**	**46,901**	**44,907**	**46,079**	**50,622**	**47,874**	**47,755**	**50,439**	**51,905**	**52,239**	**50,777**	**47,348**	**37,450**	**31,372**	**27,007**	**23,642**	**20,333**	**13,115**	**7,159**	**5,660**	**4,271**	**3,551**	**2,183**
		$/lb-Cu	$0.680																												
Wellfield																															
Labor		$000s	67,433	0	0	2,133	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	2,779	2,779	2,779	2,711	2,711	2,711	2,493	1,853	1,661	1,394	1,129	528
Supplies		$000s	313,786	0	0	0	14,826	17,215	16,367	20,087	18,322	18,553	21,339	19,481	19,916	21,161	21,926	21,319	19,624	18,729	13,020	9,572	7,251	5,661	4,374	4,319	724	0	0	0	0
Consumables		$000s	96,350	0	0	1,854	2,370	2,731	3,353	3,493	4,095	4,975	5,421	5,369	4,766	5,370	5,574	7,067	7,651	6,721	5,848	5,409	4,930	4,216	3,271	1,264	350	131	76	29	18
Subtotal Production	-	**$000s**	**477,570**	**0**	**0**	**3,987**	**20,255**	**23,006**	**22,779**	**26,640**	**25,477**	**26,588**	**29,819**	**27,909**	**27,741**	**29,591**	**30,560**	**31,445**	**30,334**	**28,229**	**21,647**	**17,759**	**14,892**	**12,588**	**10,357**	**8,075**	**2,927**	**1,792**	**1,470**	**1,158**	**546**
Contingency	10%	$000s	47,757	0	0	399	2,025	2,301	2,278	2,664	2,548	2,659	2,982	2,791	2,774	2,959	3,056	3,145	3,033	2,823	2,165	1,776	1,489	1,259	1,036	808	293	179	147	116	55
Total Production		**$000s**	**525,327**	**0**	**0**	**4,386**	**22,280**	**25,306**	**25,057**	**29,304**	**28,025**	**29,247**	**32,801**	**30,700**	**30,515**	**32,550**	**33,616**	**34,590**	**33,367**	**31,052**	**23,811**	**19,535**	**16,382**	**13,847**	**11,392**	**8,883**	**3,220**	**1,971**	**1,617**	**1,274**	**601**
		$/lb-Cu	$0.425																												
Wellfield																															
Labor																															
Insitu		$000s	67,433	0	0	2,133	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	2,779	2,779	2,779	2,711	2,711	2,711	2,493	1,853	1,661	1,394	1,129	528
Total Labor	-	**$000s**	**67,433**	**0**	**0**	**2,133**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**3,059**	**2,779**	**2,779**	**2,779**	**2,711**	**2,711**	**2,711**	**2,493**	**1,853**	**1,661**	**1,394**	**1,129**	**528**
		$/lb-Cu	0.055																												
Supplies Cost																															
Acid Makeup	3.99	kt	2,467	0	0	0	138	158	144	174	155	154	173	161	162	174	182	170	165	144	93	59	35	19	5	0	0	0	0	0	0
Quicklime		kt	497	0	0	0	7	11	15	20	21	23	30	25	27	27	27	32	23	32	27	27	27	27	29	32	5	0	0	0	0
Acid	$90.00	$000s	222,026	0	0	0	12,454	14,185	12,960	15,703	13,967	13,881	15,586	14,470	14,583	15,704	16,393	15,290	14,877	12,958	8,378	5,274	3,185	1,754	423	0	0	0	0	0	0
Acid Transport	$10.00	$000s	24,670	0	0	0	1,384	1,576	1,440	1,745	1,552	1,542	1,732	1,608	1,620	1,745	1,821	1,699	1,653	1,440	931	586	354	195	47	0	0	0	0	0	0
Quicklime	$135.00	$000s	67,090	0	0	0	988	1,454	1,968	2,639	2,804	3,130	4,021	3,403	3,712	3,712	3,712	4,331	3,093	4,331	3,712	3,712	3,712	3,712	3,904	4,319	724	0	0	0	0
Total Supplies	-	**$000s**	**313,786**	**0**	**0**	**0**	**14,826**	**17,215**	**16,367**	**20,087**	**18,322**	**18,553**	**21,339**	**19,481**	**19,916**	**21,161**	**21,926**	**21,319**	**19,624**	**18,729**	**13,020**	**9,572**	**7,251**	**5,661**	**4,374**	**4,319**	**724**	**0**	**0**	**0**	**0**
		$/lb-Cu	0.254																												
Consumables Cost																															
Well Piping Relocation	0.00	$000s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insitu Environmental	0.00	$000s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Power		$000s	55,522			912	1,268	1,504	1,860	1,984	2,309	2,810	3,113	3,079	2,705	3,053	3,175	3,983	4,470	3,999	3,467	3,213	2,922	2,486	1,910	1,093	209	1	0	0	0
Pump Motor Replace		$000s	33,366			561	780	926	1,145	1,221	1,421	1,729	1,916	1,895	1,664	1,879	1,954	2,451	2,751	2,461	2,133	1,977	1,798	1,530	1,175	0	0	0	0	0	0
Well Fail Replace/Rehab		$000s	1,821			243	99	67	98	32	94	141	85	88	115	141	144	296	162	4	2	2	1	1	1	5	0	0	0	0	0
Packers		$000s	1,726			35	49	59	73	78	91	111	123	123	108	122	126	159	89	80	69	64	58	50	38	22	0	0	0	0	0
Pressure Transducer		$000s	55			3	4	4	5	6	7	8	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel, SUVs & Pickups (6)		$000s	469			20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	10	10	7	3
Fuel, Mobile Equipment		$000s	25			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fuel, UTVs		$000s	76			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	0
Wellhead Repair		$000s	29			1	1	1	1	1	1	2	2	2	1	2	2	2	2	2	2	2	2	1	1	1	0	0	0	0	0
PLC/SCADA Component		$000s	72			0	2	2	2	3	3	4	4	4	4	4	4	5	6	5	5	4	4	3	3	2	0	0	0	0	0
Electrical Cable for Pump		$000s	8			0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pipe Repair		$000s	59			1	1	2	2	2	2	3	3	3	3	3	3	4	5	4	4	3	3	3	2	1	0	0	0	0	0
Equip Maint-Pickup		$000s	384			8	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	8	2	2
Equip Maint- UTVs		$000s	70			2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
Equip Maint-Grader		$000s	336			7	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	7	7	7
Equip Maint-Water Truck		$000s	256			6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	6	3	0
Equip Maint- Backhoe		$000s	54			1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	0
Diesel Generator Maint		$000s	96			4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	1	1
Waste/Trash Disposal		$000s	768			16	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	3	3
HazWaste Disp/Recycle		$000s	2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Load Center Repair		$000s	18			0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0