

APPENDIX D

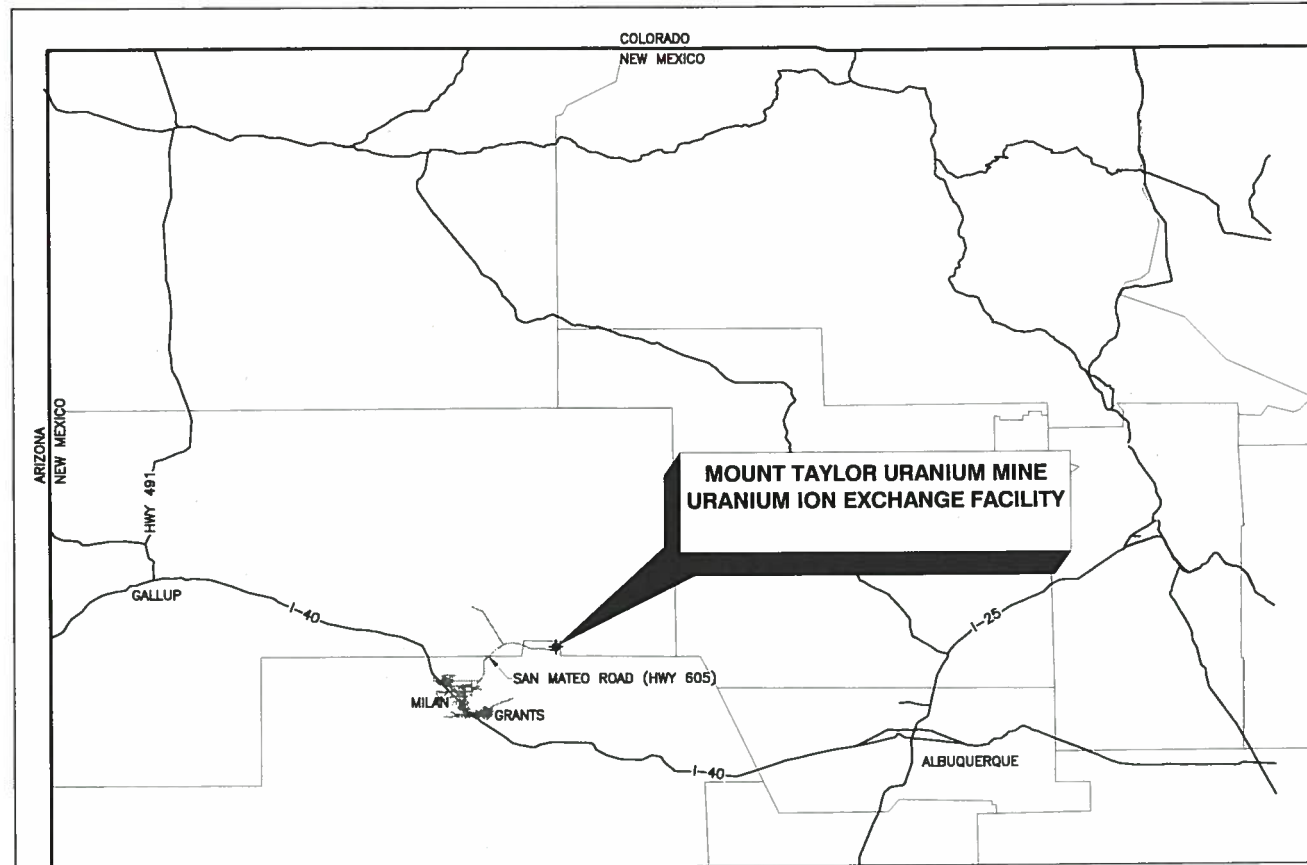
ION EXCHANGE PLANT DESIGN

- **Operation and Maintenance Manual**
 - **Plans**

CIBOLA COUNTY, NEW MEXICO

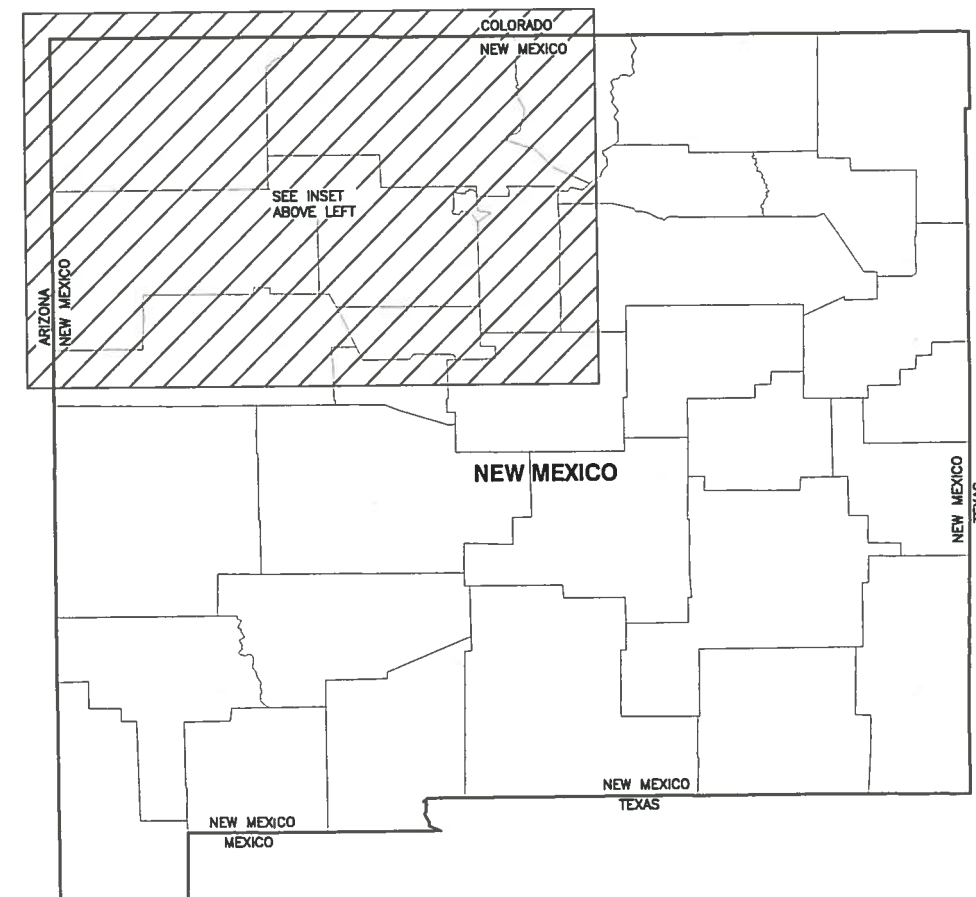
MOUNT TAYLOR URANIUM MINE/RIO GRANDE RESOURCES CORP.

URANIUM ION EXCHANGE FACILITY



LOCATION MAP
NOT TO SCALE

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10	P&ID-RESIN STORAGE AND TRANSFER



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MT. TAYLOR URANIUM MINE/RIO GRANDE RESOURCES CORP., NEW MEXICO
URANIUM ION EXCHANGE FACILITY
COVER SHEET

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1 10
JOB NO. 130040
SHEET NO. COVER SHEET
1 OF 10

FUNCTION SYMBOLS:

	CONTROL ROOM CONSOLES	FIELD MOUNTED	AUXILIARY CONTROL PANEL NORMALLY ACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS			
DCS			
COMPUTER FUNCTION			
PLC			

LINE SYMBOLS:

	FLOW LINE
	CONTROL LINE (ELECTRICAL)
	HARDWIRE
	DATA COMMUNICATIONS RS485, RS422 BETWEEN PLC AND DCS
	PID CONTROL LOOP
	AIR SUPPLY
	INTERLOCK
	SET VALUE HIGH (DCS) FOR VFD.
	SET VALUE LOW (DCS) FOR VFD.
	MANIPULATED VARIABLE FOR VFD.
	PROCESS VARIABLE FOR VFD.

LINE CONTINUATION ARROWS:

	TO/FROM ADJACENT DRAWING
	TO/FROM NON-ADJACENT DRAWING

ABBREVIATIONS

FRP	FIBERGLASS REINFORCED STEEL
RLS	RUBBER LINED STEEL
SS	STAINLESS STEEL
STEEL	CARBON STEEL
LPB	(PVC) POLYVINYL CHLORIDE
RO	RESIN IN
RI	RESIN OUT
MW	MINE WATER
RTW	RESIN TRANSFER WATER

MECHANICAL SYMBOLS:

	PUMP
	REDUCER
	FLANGE JOINT
	CAMLOCK FITTING
	FILTER
	FLEXIBLE JOINT
	VENTS
	AGITATOR
	MANHOLE
	PULSE DAMPENER
	RECEIVER
	RADIOACTIVE SOURCE
	EDUCTOR
	FLEXIBLE HOSE
	SONIC LEVEL SENSOR
	VERTICAL TURBINE PUMP

MISCELLANEOUS SYMBOLS:

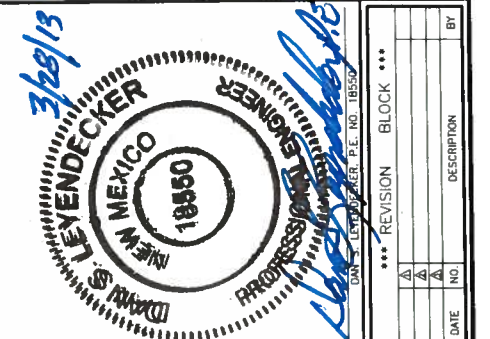
	MAG METER
	MOTOR ACTUATED VALVE WITH MANUAL HANDWHEEL
	BAG FILTER

VALVE SYMBOLS:

	VALVE - GENERAL
	VALVE - NORMALLY CLOSED
	BALL VALVE
	BUTTERFLY VALVE
	DIAPHRAGM VALVE MANUALLY OPERATED
	PRESSURE RELIEF VALVE SPRING OPERATED
	PRESSURE REDUCING VALVE OPERATED BY DOWNSTREAM PRESSURE FLOW DIRECTION
	BACK PRESSURE VALVE OPERATED BY UPSTREAM PRESSURE FLOW DIRECTION
	CHECK VALVE
	KNIFE GATE VALVE
	HAND VALVE MANUALLY OPERATED
	CONTROL VALVE - FLOW MODULATING 4-20mA /PNEUMATIC OPERATED MANUAL OVER-RIDE VXXX
	STRAINER

VALVE NOMENCLATURE

VALVE	PROCESS
VXXX	0 MINE WATER
1	1 ION EXCHANGE
2	2 RESIN OUT
3	3 RESIN IN
4	4 RESIN TRANSFER WATER



MT. TAYLOR URANIUM MINE/RIO GRANDE RESOURCES CORP., NEW MEXICO
URANIUM ION EXCHANGE FACILITY
SYMBOLS & LEGEND
(SHEET 1 OF 2)

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XX = EQUIPMENT ID

MW	MINE WATER
IX-(1-14)	ION EXCHANGE COLUMN (1-14)
RI	RESIN IN
RO	RESIN OUT
T-1	OVERFLOW TANK
T-2A	RESIN TRANSFER WATER STORAGE TANK
T-2B	RESIN TRANSFER WATER STORAGE TANK
T-3A	LOADED RESIN STORAGE TANK
T-3B	LOADED RESIN STORAGE TANK
SP-1	SUMP PUMP

P&ID SYMBOLS:
FIELD INSTRUMENTS

LI XX	LEVEL INDICATOR
FI XX	FLOW INDICATOR
LT XX	LEVEL TRANSMITTER
FT XX	FLOW TRANSMITTER
LV XX	LEVEL VALVE
FCV XX	FLOW CONTROL VALVE
LIT XX	LEVEL INDICATOR TRANSMITTER
FIT XX	FLOW INDICATOR TRANSMITTER
LS XX	LEVEL SWITCH
LSH XX	LEVEL SWITCH HIGH
LSL XX	LEVEL SWITCH LOW
LSHL XX	LEVEL SWITCH HIGH LOW
LCV XX	LEVEL CONTROL VALVE
FE XX	FLOW SENSOR ELEMENT
LE XX	LEVEL SENSOR ELEMENT
VFD XX	VARIABLE FREQUENCY DRIVE

LAHH XX	LEVEL ALARM HIGH HIGH by DCS
LAH XX	LEVEL ALARM HIGH by DCS
LAL XX	LEVEL ALARM LOW by DCS
LALL XX	LEVEL ALARM LOW LOW by DCS
FAL XX	FLOW ALARM LOW by DCS
FAH XX	FLOW ALARM HIGH by DCS
LIC XX	LEVEL INDICATOR CONTROL by DCS
FIC XX	FLOW INDICATOR CONTROL by DCS
FR XX	FLOW RECORDER by DCS



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SYMBOLS & LEGEND
(SHEET 2 OF 2)

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3	10
JOB NO.	130040
TITLE	LEGEND
SHEET NO.	3 OF 10

DRAWN BY: DWI	CHECKED BY: WLB	APPROVED BY: DSL	SCALE: SHOWN	MARCH 2013
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DATE OF REVISION	REVISION	BLOCK	***
DATE	NO.	DESCRIPTION	BY

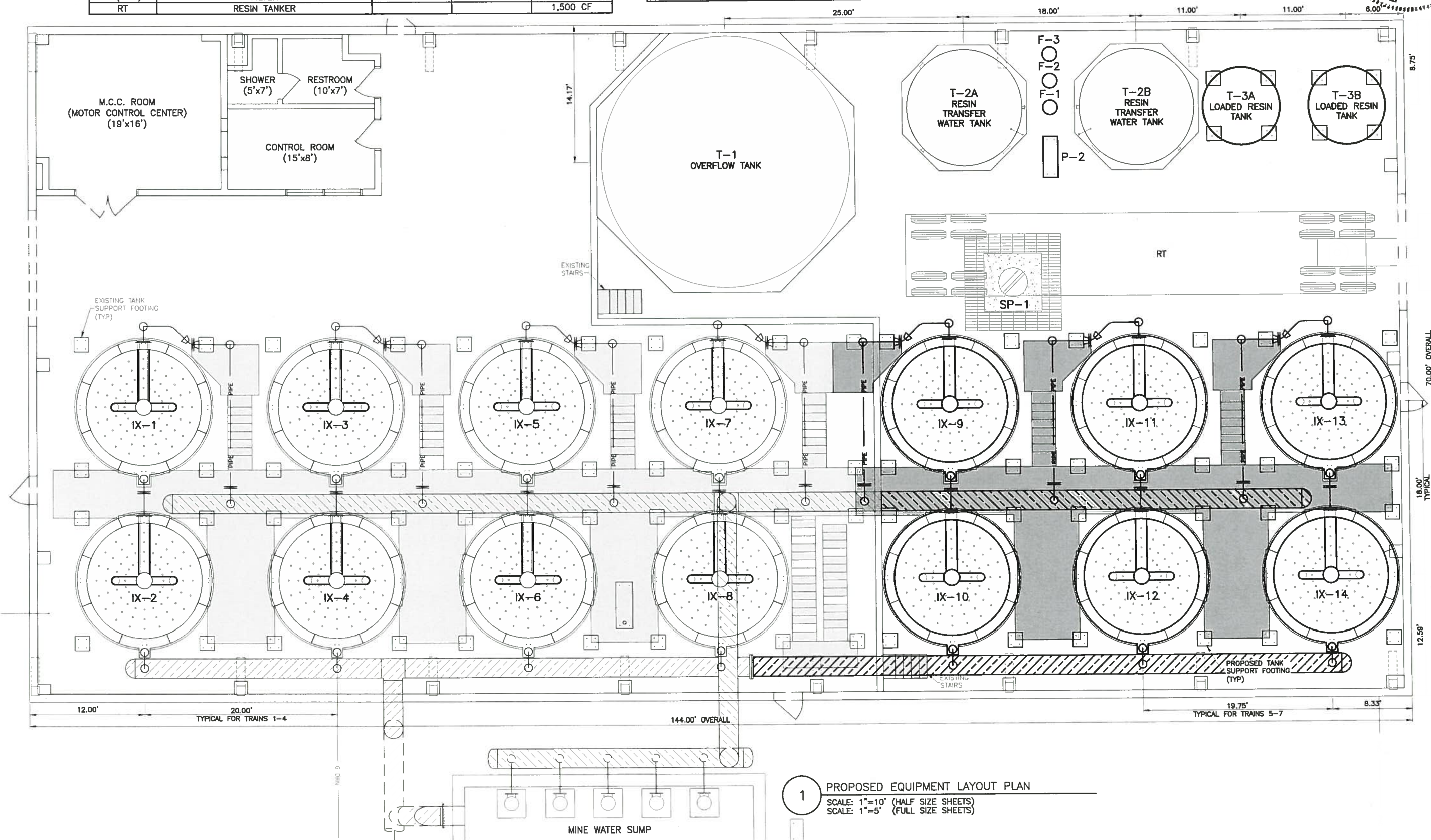
U:\New Canada Resources\130040 Mt. Taylor Mine Water Treatment\000\Drawings\Plan\04-16 PROPOSED EQUIPMENT LAYOUT.dwg
Thursday, March 28, 2013, 2:53pm

EQUIPMENT SUMMARY			
TAG	DESCRIPTION	SIZE	CAPACITY
IX-(1-8)	EXISTING IX COLUMNS WITH MODIFICATIONS	12'Ø x 12'H	10,000 GAL
IX-(9-14)	PROPOSED IX COLUMNS	12'Ø x 12'H	10,000 GAL
T-1	OVERFLOW TANK	26'Ø x 24'H	95,000 GAL
T-2A	RESIN TRANSFER WATER STORAGE TANK	12'Ø x 20'H	16,000 GAL
T-2B	RESIN TRANSFER WATER STORAGE TANK	12'Ø x 20'H	16,000 GAL
T-3A	LOADED RESIN STORAGE TANK	8'Ø x 20'H	7,500 GAL
T-3B	LOADED RESIN STORAGE TANK	8'Ø x 20'H	7,500 GAL
SP-1	SUMP AND GRATE	6'Ø x 5' DEEP	1,000 GAL
P-2	RESIN TRANSFER WATER PUMP	TBD	
F-(1-3)	FILTER	TBD	
RT	RESIN TANKER		1,500 CF

LEGEND	
	EXIST ELEVATED PLATFORM
	EXIST 24" MANIFOLD (UPPER LEVEL)
	EXIST 24" MANIFOLD (LOWER LEVEL)
	EXIST PIPE
	EXIST REDUCER
	EXIST VALVE



REVISION	DESCRIPTION	DATE	BY
1			



1 PROPOSED EQUIPMENT LAYOUT PLAN
SCALE: 1"=10' (HALF SIZE SHEETS)
SCALE: 1"=5' (FULL SIZE SHEETS)

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EQUIPMENT LAYOUT PLAN

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4	10
NO. NO.	130040
NO. NO.	PROP. EQUIP.
NO. NO.	4 OF 10

U:\Rio Grande Resources\130040.Mt. Taylor Mine Water Treatment\Drawings\Plan\IX-IX FOUNDATION CONTAINMENT PLAN.dwg
Thursday, March 28, 2013, 2:53pm

LEGEND

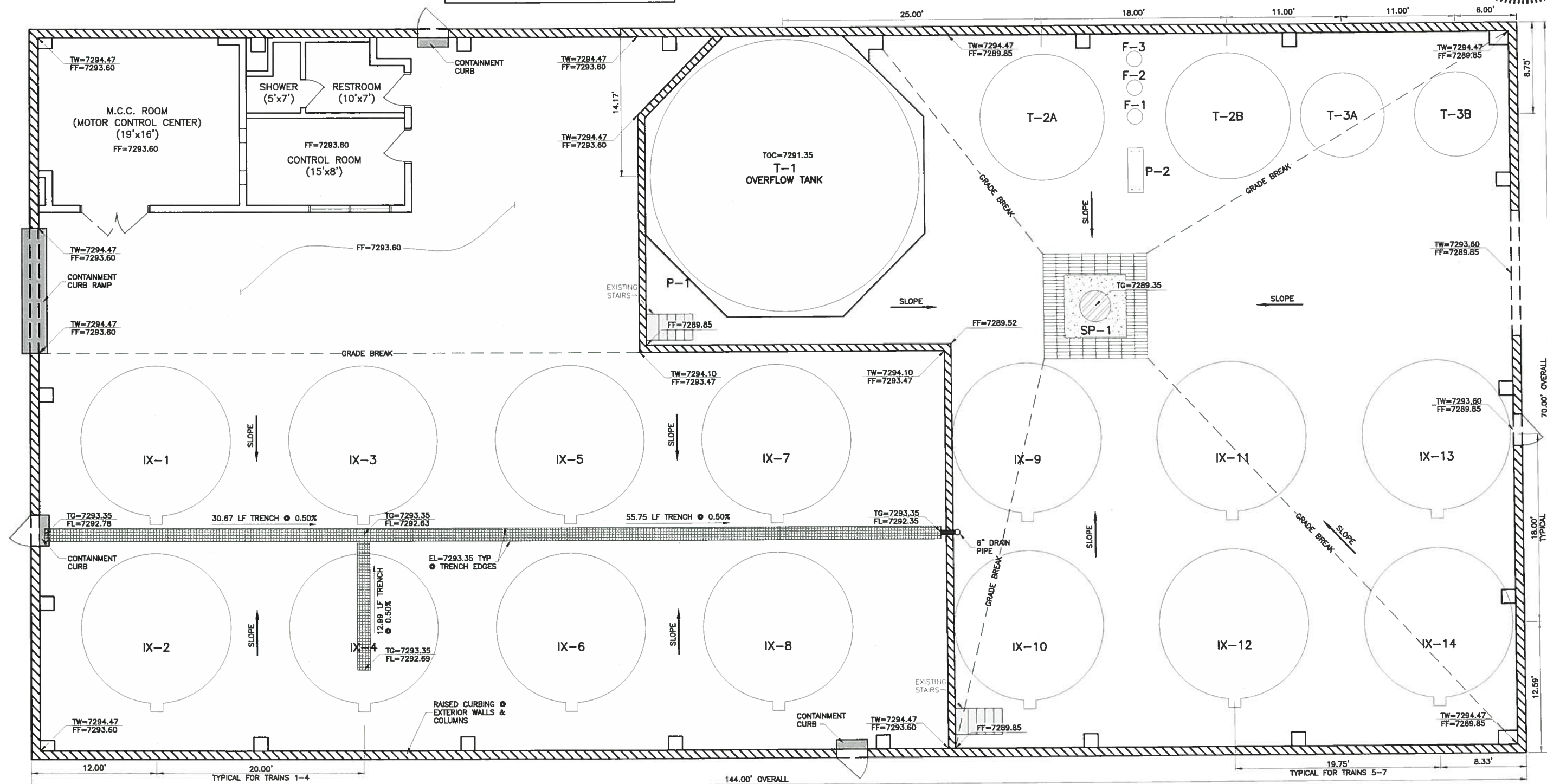
EXISTING TRENCH DRAIN

FF INDICATES FINISH FLOOR ELEVATION
FL INDICATES FLOWLINE ELEVATION
EL INDICATES ELEVATION
TW INDICATES TOP OF WALL ELEVATION
TOC INDICATES TOP OF CONCRETE ELEVATION
TG INDICATES TOP OF GRATE ELEVATION

PLANT NORTH



SCALE
1"=5' (FULL SIZE)
1"=10' (HALF SIZE)



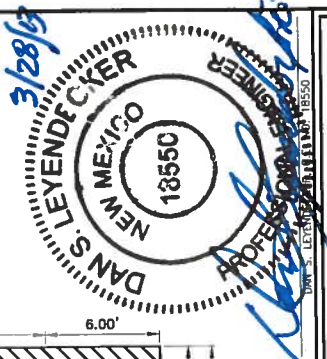
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URANIUM ION EXCHANGE FACILITY

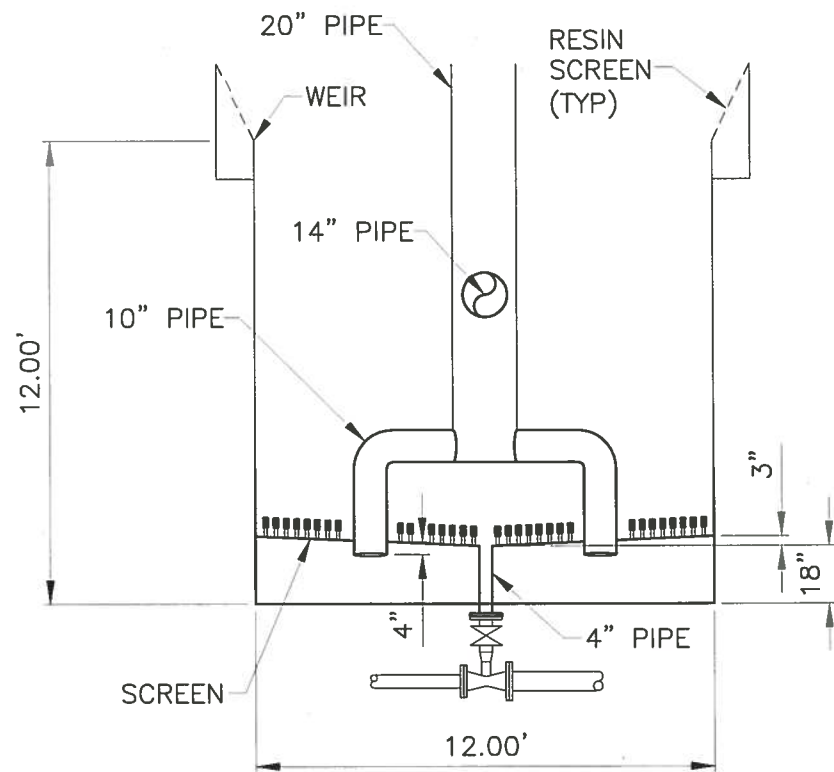
FOUNDATION CONTAINMENT PLAN

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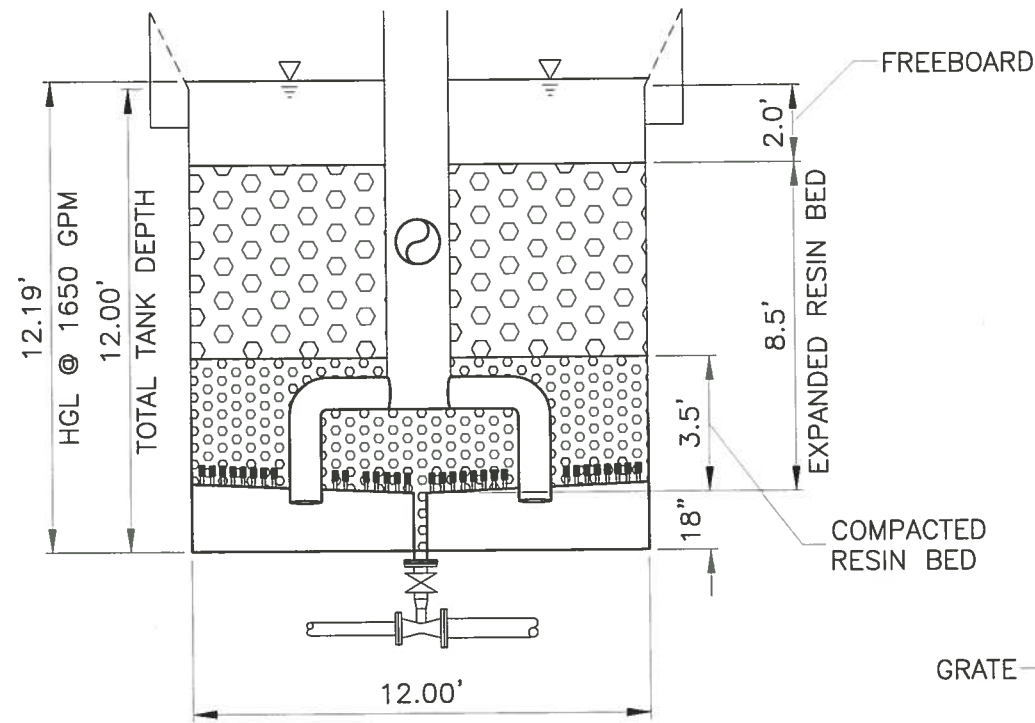
5 10
JOB NO: 130040
SHEET NO: 5 OF 10
DATE: MARCH 2013
BY: [Signature]

1 FOUNDATION CONTAINMENT PLAN
SCALE: 1"=10' (HALF SIZE SHEETS)
SCALE: 1"=5' (FULL SIZE SHEETS)

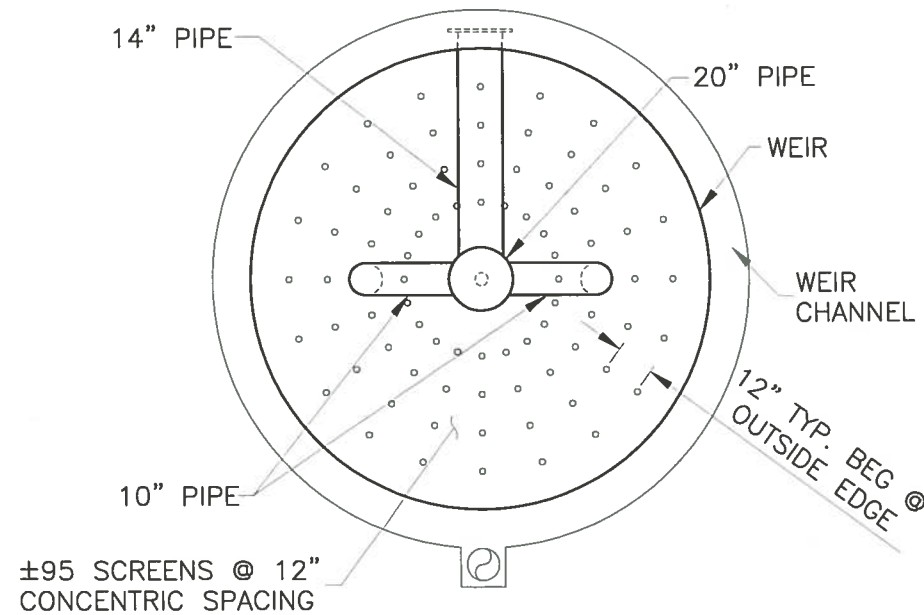




SECTION

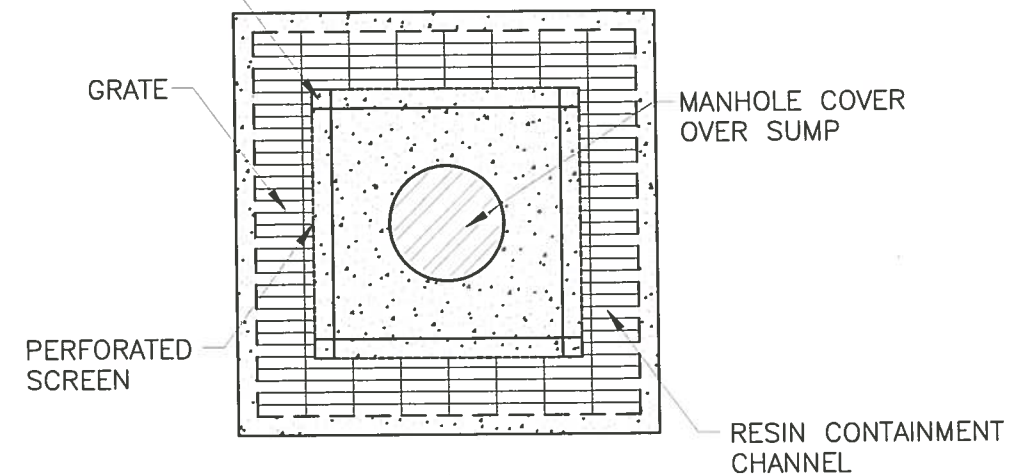
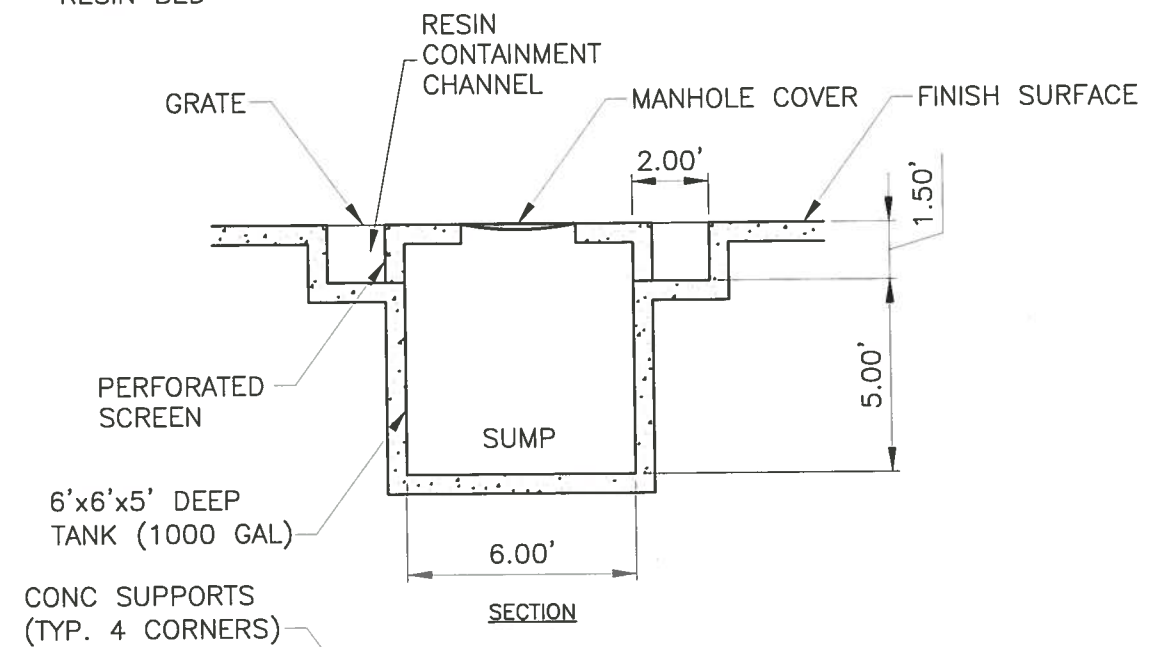


2 RESIN & HYDRAULIC PROFILE
SCALE: 1"=5' (HALF SIZE)

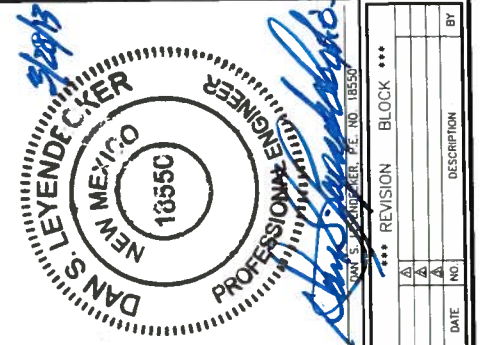


PLAN

1 IX COLUMN
SCALE: 1"=5' (HALF SIZE)



3 SUMP DETAIL
SCALE: 1"=5' (HALF SIZE)

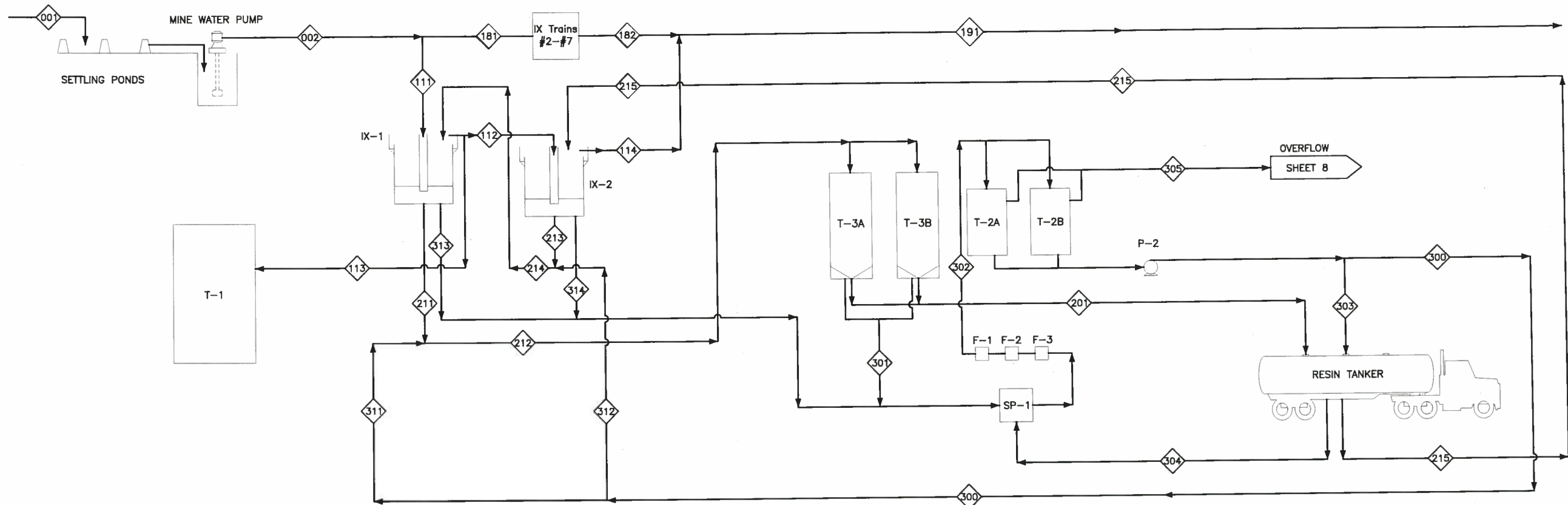


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MISCELLANEOUS DETAILS

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6 10
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SHEET NO. 6 OF 10
PROJ. EQUIP.



- NOTES:
- LEAD AND TAIL IX COLUMNS OF TRAIN NUMBER (1) OF SEVEN (7) SHOWN
 - NEW RESIN TRANSFER LINE 4" @ 5 FPS THEREFORE WATER FLOW @ 200 GPM.

XXX
 L STREAM ID
 TRAIN #
 PROCESS

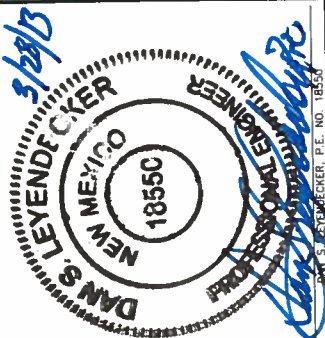
8= TRAINS 2-7 COMBINED
 0= ALL TRAINS COMBINED

PROCESS
 0 MINE WATER
 1 ION EXCHANGE
 2 RESIN TRANSFER
 3 RESIN TRANSFER WATER

1 PROCESS FLOW DIAGRAM
 NOT TO SCALE

FLOW AND MASS BALANCE

PROCESS			ION EXCHANGE									RESIN TRANSFER						RESIN TRANSFER WATER										
STREAM NO.			001	002	111	112	113	114	181	182	191	201	211	212	213	214	215	300	301	302	303	304	305	311	312	313	314	
DESCRIPTION			RAW MINE WATER	SETTLED MINE WATER	TRAIN #1 LEAD COLUMN FEED	TRAIN #1 LEAD COLUMN DISCHARGE / TAIL COLUMN FEED	OVERFLOW	TRAIN #1 TAIL COLUMN TREATED WATER	IX TRAINS #2 - #7 FEED	IX TRAINS #2 - #7 TREATED WATER	TRAINS #1- #7 TREATED WATER	LOADED RESIN TO RESIN TANKER	TRAIN #1 LEAD COLUMN LOADED RESIN	LOADED RESIN AND RTW	TRAIN #1 TAIL COLUMN PARTIALLY LOADED RESIN	PARTIALLY LOADED RESIN AND RTW	STRIPPED RESIN	RTW TO EDUCTOR OF LEAD OR TAIL IX COLUMN	LOADED RESIN STORAGE TANK RTW RETURN	FILTERED WATER BACK TO RTW STORAGE TANK	RESIN TRANSFER WATER TO RESIN TANKER	RESIN TANKER WATER TO SUMP	RESIN TRANSFER WATER STORAGE TANK OVERFLOW	RTW TO EDUCTOR OF LEAD COLUMN	RTW TO EDUCTOR OF TAIL COLUMN	TRAIN #1 LEAD COLUMN RTW RETURN	TRAIN #1 TAIL COLUMN RTW RETURN	
ION EXCHANGE	Q _{IX}	(gpm)	10,000	10,000	1,429	1,429	-	1,429	8,571	8,571	10,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Q _{IX}	(ft ³ /min)	1,337	1,337	191	191	-	191	1,146	1,146	1,337	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	SOLIDS	(mg/L)	1,000	100	100	100	-	100	100	100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	SOLIDS	(Tons/h)	2.5	0.25	0.04	0.04	-	0.04	0.21	0.21	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TOTALS	TRANSFER TIME	(min)	-	-	-	-	-	-	-	-	-	120	120	120	120	120	120	120	120	120	120	120	-	120	120	120	120	
	SP.GR. LIQUOR		1	1	1	1	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	1	1	1	
	U ₃ O ₈	(mg/l)	0.1	0.1	0.1	0.020	-	0.017	0.1	0.017	0.017	0.3	961	0.3	35	0	-	-	-	-	-	-	-	-	-	-	-	
	U ₃ O ₈	(lbs/day)	12	12	1.7	0.34	-	0.29	10.3	1.8	2.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	U ₃ O ₈	(lbs/ft ³)	0	0	0	0	-	0	0	0	0	0	0.06	0	0.002	0	-	-	-	-	-	-	-	-	-	-	-	
	Q _{TOTAL}	(gpm)	10,000	10,000	1,429	1,429	-	1,429	8,571	8,571	10,000	225	25	225	25	225	225	200	200	200	200	200	-	200	200	200	200	
	Water	(Tons/h)	2,502	2,502	357	357	-	357	2,145	2,145	2,502	56	6	56	6	56	56	50	50	50	50	50	-	50	50	50	50	
	TOTAL	(Tons/h)	2,505	2,503	358	358	-	358	2,145	2,145	2,503	56	6	56	6	56	56	50	50	50	50	50	-	50	50	50	50	
	RESIN TRANSFER	Q _{RESIN}	(gpm)	-	-	-	-	-	-	-	-	-	25	25	25	25	25	25	-	-	-	-	-	-	-	-	-	-
		Q _{RESIN}	(ft ³ /min)	-	-	-	-	-	-	-	-	-	3.3	3.3	3.3	3.3	3.3	3.3	-	-	-	-	-	-	-	-	-	-
V _{RESIN}		(ft ³)	-	-	-	-	-	-	-	-	-	400	400	400	400	400	400	-	-	-	-	-	-	-	-	-	-	
RESIN TRANSFER WATER	Q _{RTW}	(gpm)	-	-	-	-	-	-	-	-	-	200	-	200	-	200	200	200.0	200.0	200.0	200	200	-	200.0	200.0	200.0	200.0	
	Q _{RTW}	(ft ³ /min)	-	-	-	-	-	-	-	-	-	27	-	27	-	27	27	27	27	27	27	27	-	27	27	27	27	

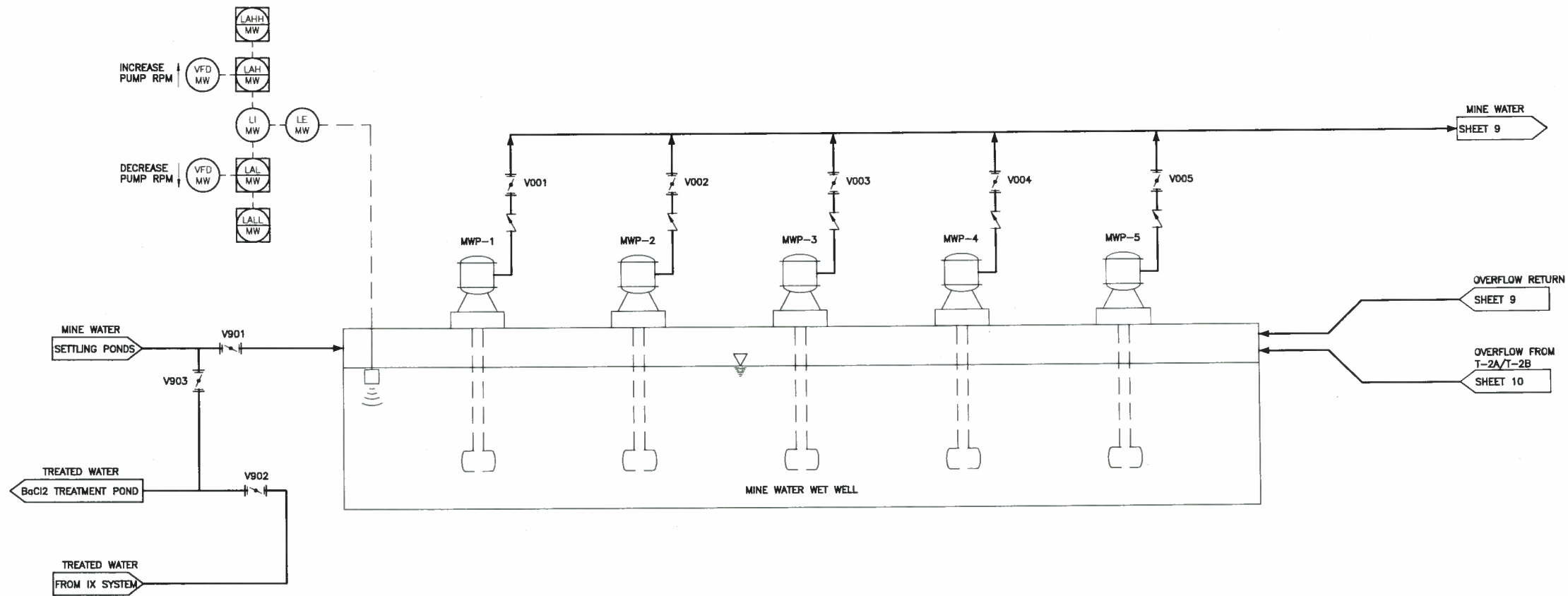


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 URANIUM ION EXCHANGE FACILITY

PROCESS FLOW DIAGRAM

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7 10
 130040
 PFD
 7 OF 10



MWP-1 MWP-2 MWP-3 MWP-4 MWP-5

MINE WATER TRANSFER PUMPS

GPM 2500 @ 40 HEAD
MOTOR HP: 40
MATERIAL: CAST STEEL, BRONZE TRIM

MINE WATER WET WELL

SIZE: 30'x6'x8'
CAPACITY: 10,800 GALLONS

3/24/13

DAN S. LEYENDECKER
NEW MEXICO
18350
PROFESSIONAL ENGINEER

DATE: 3/24/13
DRAWN BY: JLB
CHECKED BY: JLB
APPROVED BY: JLB
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MARCH 2013

NO.	REVISION	DESCRIPTION
1		
2		
3		
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5		
6		
7		
8		
9		
10		

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P&ID-MINE WATER WET WELL

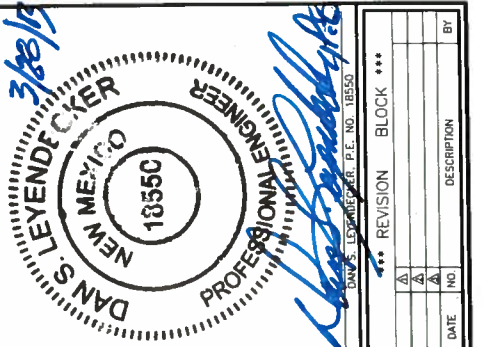
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SCALE: SHOWN
MARCH 2013

** LEAD AND TAIL IX COLUMNS OF TRAINS ONE
(1) AND TWO (2) OF SEVEN (7) SHOWN

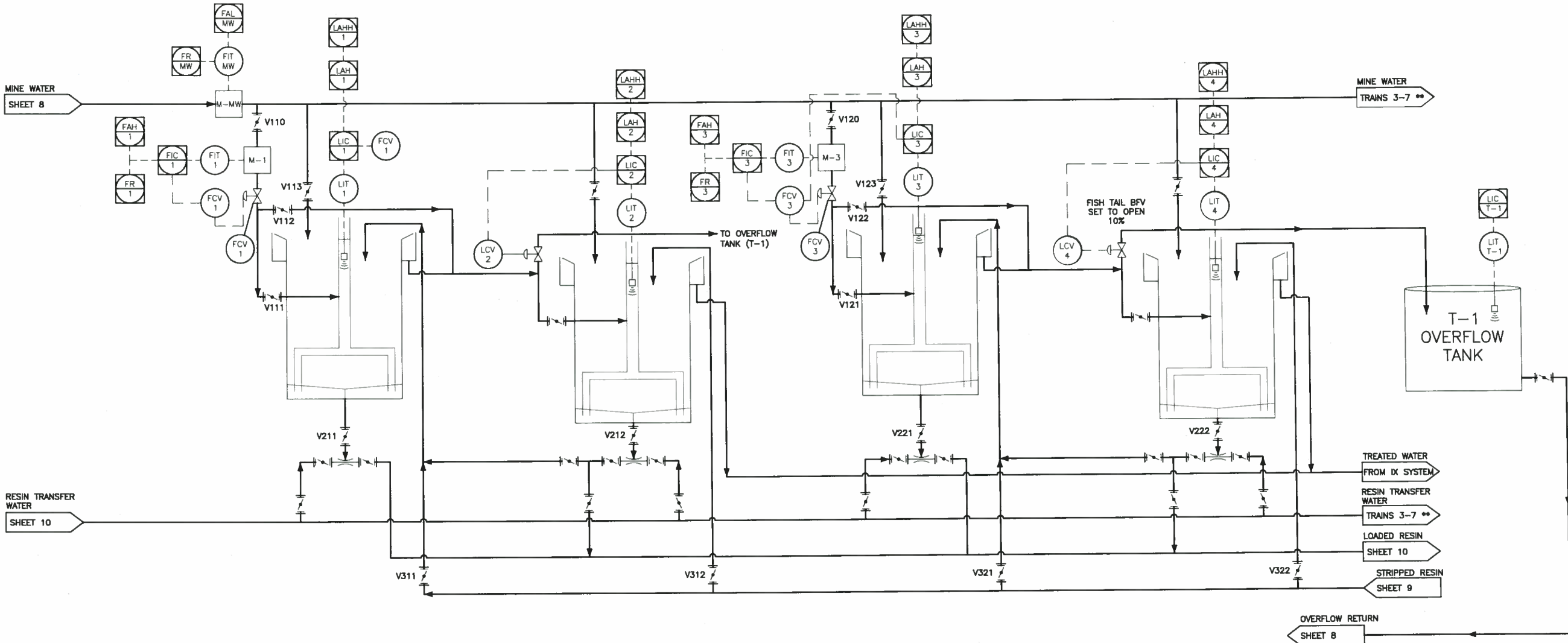


IX-1
LEAD COLUMN
TRAIN #1

IX-2
TAIL COLUMN
TRAIN #1

IX-3
LEAD COLUMN
TRAIN #2

IX-4
TAIL COLUMN
TRAIN #2



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URANIUM ION EXCHANGE FACILITY

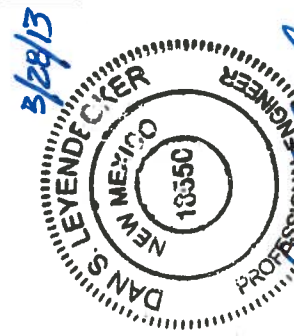
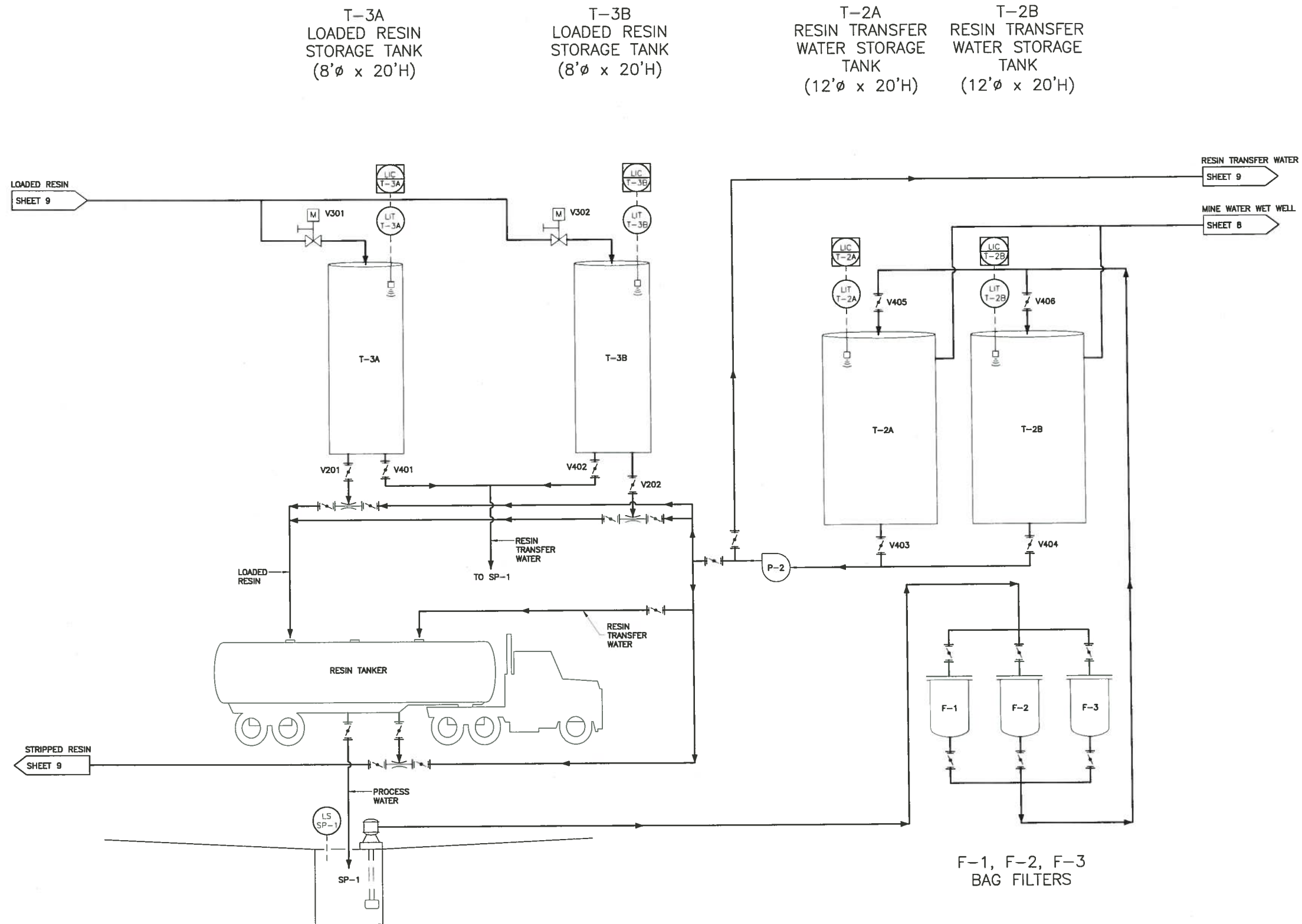
P&ID--ION EXCHANGE COLUMNS
(TRAINS 1 & 2)

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9 10
JOB NO. 130040
TAB NO. IX PID
SHEET NO. 9 OF 10



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URANIUM ION EXCHANGE FACILITY
P&ID—RESIN STORAGE AND TRANSFER

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10 10
JOB NO: 130040
SHEET NO: RS PID
SHEET NO: 100P 10

DATE	NO	REVISION	BLOCK	DESCRIPTION	BY
MARCH 2013					

Operations & Maintenance Manual

Mt. Taylor Mine Mine Water Treatment Unit (MWTU) - IX Facility

LVN Project No. 130040



RIO GRANDE RESOURCES CORPORATION

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Hobson, TX 78117

Prepared by:

LVN

engineers | architects | contractors

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Dan S. Leyendecker, P.E.

March 28, 2013

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MT. TAYLOR URANIUM IX PLANT OPERATING MANUAL

I. Background Information

Rio Grande Resources (RGR) plans to re-open the Mt. Taylor uranium mine located outside of Grants, New Mexico. The existing mine has to be dewatered to enable access to the ore. To dewater the existing mine works and operate the mine in the future, an extensive water management system must be run in combination with a Mine Water Treatment Unit (MWTU) to remove uranium (U) from the mine water to enable discharge to an NPDES-permitted outfall north of the mine.

The water treatment will be operated in two main phases:

Phase 1 - Mine de-watering phase:

- Flow 8,000 -10,000 gallons per minute (gpm)
- U 0.07 parts per million (ppm) trend increasing
- TDS ~ 400 (ppm)

Phase 2 - Mine operation:

- Flow 4,000 -5,000 gpm
- U about 1 ppm (previous mining conditions, late phase)
- TDS 800 ppm

Discharge requirements:

- 30 parts per billion (ppb) U (human health standard in 20.6.2.3103.A(12)NMAC)

RGR considers U removal by ion exchange (IX) using the existing IX plant at the site as the primary option. IX loaded resin will be transferred to an off-site facility, duly licensed by the Nuclear Regulatory Commission (NRC) or an Agreement State, to be regenerated. The stripped resin will then be returned for reuse at the IX Plant.

RGR has put together a uranium removal system utilizing a proven IX process to meet the drinking water standard discharge requirements. The system will incorporate IX trains each consisting of two IX columns in series. Each IX column will have a load capacity of 400 cubic feet (ft³) of IX resin with a maximum loading capacity of 0.09 pounds of U per cubic foot of resin. Each train has been designed to handle a maximum flow rate of 1,650 gpm and will be operated at a nominal flow rate of 1,429 gpm. The individual trains will be sampled and assayed to insure that the discharge water will not exceed the discharge limits for uranium of 30 ppb. The IX columns are designed to transfer the resin in the lead IX column when it reaches a loading of about 0.06 pounds of U per cubic foot, to prevent discharge exceeding 30 ppb U. The loaded resin from the lead IX column will be transferred to one of two loaded resin storage tanks and then will be off loaded to a resin tanker. The resin tanker will transport the loaded resin to an off-site facility for regeneration.

Each of the IX columns will be operated in an up flow mode with safeguards to prevent resin leakage between IX columns or resin spills. Each of the IX columns will have safety devices to prevent resin spills as follows: 1) resin screens in the overflow of each column, 2) a level control system that will reduce the input flow rate to the lead IX column; and 3) a bypass on the tail column to reroute bypass fluid to an overflow storage tank. The fluid sent to the overflow storage tank will be recycled back to the main supply wet well where it will be fed to the lead IX column.

II. Plant Function

The Mt. Taylor IX Plant is designed to treat 10,000 gpm of mine water for removal of uranium. The ion exchange process for recovering uranium from mine water utilizes a quaternary amine incorporated onto a porous styrene divinylbenzene bead. The amine has the ability to give up anions in exchange for anions in solution, in this case, uranium. When loaded with uranium to 0.06 pounds U per cubic foot the resin will be transported to an offsite facility to be regenerated with a concentrated brine solution in a split elution cycle. The regenerated resin will be returned to Mt. Taylor to be reused.

The following drawings should be referred to in conjunction with this Operation and Maintenance Manual (O&MM):

<u>Drawing No.</u>	<u>Description</u>
2	Symbols & Legend (Sheet 1 of 2)
3	Symbols & Legend (Sheet 2 of 2)
4	Equipment Layout Plan
5	Foundation Containment Plan
6	Miscellaneous Details
7	Process Flow Diagram
8	P&ID - Mine Water Wet Well
9	P&ID - IX Columns (Trains 1 & 2)
10	P&ID - Resin Storage and Transfer

III. Facility Description

Refer to Drawing Number 4 - Equipment Layout Plan for the location of the various items described below. The Mt. Taylor IX Plant consists of five mine water pumps, four operating and a spare, seven IX trains with two IX columns each (14 columns total), two loaded resin storage columns, one overflow storage tank and two resin transfer water storage tanks. All of the above equipment except the mine water pumps are enclosed within the building. Also housed inside of the building are the motor control center (MCC), office, control room and restroom.

A. Mine Water Pumping

Mine Water gravity flows from the treatment lagoons to a wet well located adjacent to the IX building on the south side. The wet well has dimensions of 30

ft. x 6 ft. x 8 ft. 4 in. deep. The mine water wet well is covered by a platform which supports the five mine water transfer pumps (MWP-1, 2, 3, 4, and 5). Each mine water pump has a capacity of 2,500 gpm. For the plants' capacity of 10,000 gpm, four pumps are operating with one full spare.

B. Ion Exchange

The IX portion of the facility is located within the building and consists of seven trains of two IX columns each (14 columns total). Each train has a capacity of 1,650 gpm or one-sixth the total plants flow. The IX trains are arranged so that water will gravity flow from the first (lead) column (IX-1, 3, 5, 7, 9, 11, and 13) in each train to the second (tail) column (IX-2, 4, 6, 8, 10, 12, and 14). Water from the tail column in each train will then gravity flow to the plant discharge. Each column is provided with overflow screens to prevent resin loss. Each column has a diameter of 12 ft with a 12 ft straight sidewall, and is loaded with approximately 400 ft³ of resin.

C. Resin Transfer

The resin transfer system consists of two resin transfer water storage tanks (T-2A/2B), a single process water pump (P-2), and two loaded resin storage tanks (T-3A/3B). The resin is transferred as a slurry with water and will incorporate the use of eductors at each vessel. Eductors are a type of device that uses liquid pressure as a motive force to effectively convey granular solids or slurries over relatively short distances. The eductors are supplied with process water from a 200 gpm centrifugal pump which is sufficiently sized for transferring resin from one vessel at a time.

Once the resin has been loaded with uranium in the IX columns, the resin from a given column will first be transferred to one of two loaded resin storage tanks, each capable of holding 1,000 ft³ of resin. The purpose of the loaded resin storage tank is to temporarily hold loaded resin while it awaits transport to the offsite facility for regeneration. The loaded resin will then be transferred to a resin tanker that can hold up to 1,500 ft³ of resin. This resin tanker will transport the loaded resin to the regeneration facility and then return regenerated resin back to Mt. Taylor to be put back into service.

Facilities are provided for hydraulic transport of the resin between the IX columns, loaded resin storage tanks, and resin tanker. To reduce water consumption, water used to transport resin throughout the facility will be recycled and stored in the resin transfer water storage tanks.

D. Instrumentation

The control system that RGR proposes to install in the IX Plant will be a computer-based system. It will incorporate an active screen for each process and will display real time activities of tank levels and process flow rates. This system will have input from flow transmitters and level transmitters. The IX system will

be monitored by operators and a Programmable Logic Controller (PLC) located in the control room.

E. Plant Utility

The following utility services are provided at the IX Facility: electricity, potable water, process water and instrument air. A 13.8 KV line delivers primary power from the Mt. Taylor Mine to a transformer for conversion to 440/220 volts. Distribution to plant users is through the MCC. Potable water is delivered to the IX Facility through an underground line originating at the Barium Chloride Building. Process water is provided at appropriate locations at a pressure of 60 pounds per square inch (psi). Filtered and dried instrument air is supplied by a 23.5 actual cubic feet per minute (ACFM) compressor at 100 psi for operation of pneumatic controls.

F. Support Facilities

Forced air heating is provided for the entire IX building. The office, MCC and restroom are air conditioned.

IV. Plant Operation

A. Mine Water Pumping

Refer to Drawing 8 - P&ID - Mine Water Wet Well

- 1) The mine water wet well is equipped with an inlet line from the mine water ponds and a bypass line that can in emergency situations feed excess water to the radium removal system.
- 2) Under normal operations Valves V901 and V902 are fully open and the Isolation Valve V903 is closed.
- 3) The mine water pumping system is designed so that four of the five mine water transfer pumps will provide the necessary capacity. The fifth pump provides backup capacity.
- 4) Before starting the mine water pumps, the operator should select the desired wet well level for the level indicator controller (LIC located in the control room).
- 5) Two IX trains will be valved open to accept mine water flow and one mine water pump will be turned on. The operator will adjust fluid flow through both IX trains prior to placing a second pump and any additional trains in

service. This procedure will be followed until the desired water flow is obtained.

- 6) The mine water wet well is provided with level control which will automatically maintain a constant level within the wet well. This is accomplished through the use of Variable Frequency Drive (VFD) on each mine water pump (MWP-1, MWP-2, MWP-3, MWP-4 and MWP-5). The level controller is set at a predetermined elevation that will adjust the VFD accordingly to maintain this level set point. The level device will be installed in the wet well to cover the operating level range. In the event that the level continues to increase, the operator must manually reduce the incoming fluid to the mine water wet well. If the level drops below the low-low setting, the pumps will sequentially turn off to protect the pumps from insufficient fluid level.
- 7) To shut off the flow of water to the IX Plant, the following sequence should be observed:
 - Open Valve V903
 - Close Valves V901 & V902

The IX Plant will now be bypassed and all mine water will flow from the settling ponds to the Barium Chloride Treatment Facility.

- 8) To initiate flow of mine water to the IX Plant, the following sequence should be observed:
 - If Closed, Open Valves V901 & V902
 - Close Valve V903

The operator should visually observe the water levels in the mine water wet well at the IX Plant to insure that no obstructions are impeding the flow of water.

B. Ion Exchange

Refer to Drawing 9 - P&ID - IX Columns (Trains 1 & 2)

The IX Plant will utilize seven identical trains. Each train will have a capacity of 1,650 gpm and will consist of two (2) 12-foot diameter columns in each train. The operation of one train is described below as an example. The components and functions will be identical for the remaining trains.

Feed water is delivered by the mine water transfer pumps to the main plant header. This 24-inch diameter header is located above the IX columns. A mag

meter (M-MW) is located in the header with a flow recorder (FR-MW) and low flow alarm (FAL-MW) is located in the control room.

Prior to initiating flow to the IX columns, the operator should check the resin drain Valves V211 and V212, located below the IX column tank, to insure that they are both closed. Valves V112 and LCV-2 should be closed. Valve V110 should now be opened. The flow control valve (FCV-1) will regulate the flow to the IX train.

To begin flow to the Lead IX column, open Valve V110, check to make sure V112 and LCV-2 are closed and set FCV-1 to 25 percent of desired flow rate. Check the resin depth in the column and make sure flow has been established throughout train number one. Repeat this on train number 2 and then start increasing the flow rate through both trains by adjusting the VFD on the mine water pump and FCV to the desired flow rate.

The IX trains are designed with the capability of bypassing both the lead and tail IX columns. The FCV or LCV (LCV for tail column and FCV for lead column) will maintain a constant level in the IX column by opening and closing depending on observed levels and flow rates. If the LCV or FCV fails and the level increases past the first set point the operator will be notified by the level alarm high (LAH). In the event that the LCV still cannot control the flow, the level will continue to increase to the second set point. At this point, the operators will place the spare IX train in service which will receive flow diverted from the upset IX column. If the spare train is not ready to receive flow, the level alarm high high will sound and the bypass valve will open automatically. This will divert flow from the upset Tail IX column to the overflow storage tank.

C. Resin Transfer

Refer to Drawing 7 - Process Flow Diagram

Refer to Drawing 9 - P&ID - IX Columns (Trains 1 & 2)

Refer to Drawing 10 - P&ID - Resin Storage and Transfer

When the resin in the lead column of an IX train is loaded to about 0.06 pounds/ft³ with uranium, a resin transfer cycle will begin and proceed in the following order.

1. The resin will first be transferred from the lead IX column to the loaded-resin storage tanks.
2. The partially loaded resin from the tail IX column will then be transferred to the lead IX column.
3. Stripped (regenerated) resin will be transferred from the resin tanker to refill the tail IX column.
4. Loaded resin will be transferred from a loaded resin storage tank to the resin tanker.

The loaded resin will be removed from the lead IX column(s) (IX-1, 3, 5, 7, 9, 11, 13) by an eductor, where it is fluidized by the resin transfer water and conveyed through a 4" steel pipe at 200 gpm to the loaded resin storage columns. The transfer lines between each IX column have a clear inline sight glass so that the operator can determine when all of the resin has been removed. The inline sight glass will also allow the operator to ensure that the resin is in fact moving out of the IX column. The loaded resin storage columns (T-3A and T-3B) are located in the northeast quadrant of the building and are 8 ft in diameter by 20 ft high. The resin transfer water pump (P-2) will provide water from the resin transfer water storage tanks (T-2A and T-2B) at the necessary flow rate and pressure to fluidize the resin and transport it through the resin transfer cycle.

The partially loaded resin will then be removed from the tail IX column by an eductor and hydraulically transported to the lead IX column. This process will begin immediately after the loaded resin has been removed from the lead IX column.

The regenerated ion exchange resin will be transferred hydraulically from the resin tanker to the tail IX column(s) (IX-2, 4, 6, 8, 10, 12, or 14). This process will begin immediately after the partially loaded resin has been removed from the tail IX column, and transferred to the lead IX column.

The loaded resin will then be transferred from either T-3A or T-3B to the resin tanker. The resin transfer volume from the loaded resin storage tanks to the resin tanker is determined by the level indicator controller. The operator will open the resin tanker compartment hatch and drop the resin transfer hose into the designated receiving compartment. Once this is complete, the resin transfer water pump (P-2) and the resin outlet valve for either of the resin storage tanks will open. The "resin out" valve will close when the level indicator controller reaches a predetermined level change equal to 400 ft³. Excess water drained from the resin tanker during the resin transfer process will be picked up by a sump (SP-1), and pumped through a filter (F-1, F-2, or F-3) prior to being sent back to resin transfer water storage tanks (T-2A or T-2B). The reason for filtering and recycling is to minimize water consumption. The hose connection from the tanker to the resin eductor will have a "no-spill" check valve and a clear sight glass. The purpose of the sight glass will be to provide the operator with a view of the media being transferred, enabling the operator to determine when all of the resin has been transferred. The no-spill check valve will prevent water and/or resin from spilling during connection and disconnection.

D. Instrumentation

1. Mine Water Sump and Pumps

Mine Water Transfer Pumps will have local start-stop switches with a stop only switch located in the control room. In the event of low level in the mine water sump, the level indicator controller (LIC-MW) will adjust the

pump speed and activate the level alarm low (LAL-MW) in the control room. Further reduction in level by 12 inches will trip level alarm low low (LALL-MW) and all pumps. The mine water wet well will also be provided with an overflow line to prevent the sump from overtopping. This sump overflow will go directly to the radium removal system.

Mine Water transfer pumps should hold a discharge pressure of at least 10 psi for proper operation of flow control valves at the IX columns.

The 24" diameter mine water header flow will be monitored downstream of the process water take-off. A recorder and low flow alarm will be provided in the control room. The low flow alarm point will be set at 2500 gpm.

2. Lead IX Columns

The control system proposed for the IX facility will display real time activities of tank levels and process flow rates by receiving input from transmitters and indicators throughout the plant. The instrumentation, placement, and function of the controls system is described below.

Flow of mine water to each IX column will be controlled either at the valve or in the control room as described below. Local flow readout will be provided for manual control.

Primary Control

The first magnetic flow meter (mag meter) monitoring each train will be placed on the common header. The mag meter (M-MW) will measure the total flow being delivered to the IX process by the pumps. The mag meter output signal will be transmitted through the flow indicator transmitter (FIT-MW) to the flow recorder (FR-MW) and the flow alarm low (FAL-MW). The FR-MW will record the real time flow and store it digitally for record keeping. The flow alarm low (FAL-MW) will activate or deactivate if the flow is below the pre-determined set point. FAL-MW will be an audible and visible alarm to alert the operator and other personnel of an inadequate flow rate. Downstream of M-MW the flow will enter a common header and be divided into the seven trains.

Each of the seven lead IX columns will be equipped with a mag meter (M-1, 3, 5, 7, 9, 11, 13) located on the supply line to each of the seven trains. The mag meter will be upstream of the flow control valve (FCV-1, 3, 5, 7, 9, 11, 13) and the lead column. The mag meter will measure the flow being delivered to each IX column. The mag meter output signal will be transmitted through the flow indicator transmitter (FIT-1,3, 5, 7, 9, 11, 13) to the flow indicator controller (FIC-1, 3, 5, 7, 9, 11, 13) and flow recorder (FR-1, 3, 5, 7, 9, 11, 13), both of which will be located in the control room. The flow recorder will digitally record data for recordkeeping. The

flow indicator controller will be programmable so that the operator can set it to maintain a desired flow rate. The flow indicator controller will send a signal to a flow control valve which will open and close to maintain the desired flow rate set on the flow indicator controller. The flow indicator controller will also activate or deactivate the flow alarm high (FAH-1, 3, 5, 7, 9, 11, 13). The flow alarm high will be an audible and visible alarm whose set point can be determined and programmed by the operator.

Secondary Control

Each of the seven lead IX columns will be equipped with a sonic level sensor, located in the column tank, which will send its output signal to a level indicator transmitter (LIT-1, 3, 5, 7, 9, 11, 13). The level indicator transmitter will transmit a signal to the level indicator controller (LIC-1, 3, 5, 7, 9, 11, 13). The level indicator controller will be located in the control room and display the water level in each lead column in real time. The level indicator controller will also be programmable to maintain a certain set point level. The purpose of the level indicator controller is to monitor tank levels and to insure that the levels are not high enough to overtop the tanks and cause a spill. The level indicator controller will communicate to the lead column flow control valve (FCV-1, 3, 5, 7, 9, 11, 13), the level alarm high (LAH-1, 3, 5, 7, 9, 11, 13), and the level alarm high high (LAHH-1, 3, 5, 7, 9, 11, 13). In the event that the first level set point has been reached the level indicator controller will activate the level alarm high to notify the operator. The level indicator controller will also adjust the flow control valve appropriately to maintain the programmed set point and prevent a spill. In the event that the level indicator controller is not able to resolve the abnormally high water level by manipulating the flow control valve and the second set point is reached, the level indicator controller will activate the level alarm high high and the operator will be able to manually divert the entire flow around the high level column to the tail IX column. The tail IX columns will have the ability to divert excess flow from the lead IX columns to the overflow storage tank (T-1).

3. Tail IX Columns

Each of the seven tail IX columns will be equipped with a sonic level sensor, located in the column tank, which will send its output signal to a level indicator transmitter (LIT-2, 4, 6, 8, 10, 12, 14). The level indicator transmitter will transmit a signal to the level indicator controller (LIC-2, 4, 6, 8, 10, 12, 14). The level indicator controller will be located in the control room and display the water level in each tail column in real time. The level indicator controller will also be programmable to maintain a certain set point level. The purpose of the level indicator controller is to monitor tank levels and to insure that the levels are not high enough to overtop the tanks and cause a spill. The level indicator controller will communicate to the tail column level control valve (LCV-2, 4, 6, 8, 10,

12, 14), the level alarm high (LAH-2, 4, 6, 8, 10, 12, 14), and the level alarm high high (LAHH-2, 4, 6, 8, 10, 12, 14). In the event that the first level set point has been reached the level indicator controller will activate the level alarm high to notify the operator, the level indicator controller will also adjust the level control valve appropriately to maintain the programmed set point and prevent a spill. In the event that the level indicator controller is not able to resolve the abnormally high water level by manipulating the level control valve and the second set point is reached, the level indicator controller will activate the level alarm high high. When the level alarm high high is activated the level control valve will be closed 100% and all flow to the tail IX column will be diverted to the overflow storage tank (T-1).

E. Quality Control of Discharge Fluids

1. Sampling of Discharge Fluids

- a. Composite sampling will be performed for all IX Tail columns, total discharge stream of the IX system and the total discharge stream leaving the facility.
- b. This composite sampling will be on an eight (8) hour schedule and will incorporate a duplicate sample bottle for third party assay.
- c. The operator will grab samples every eight (8) hours from each lead and tail IX column to determine when resin transfer must occur to keep the system discharge stream below the 30 ppb standard for uranium.

2. Test Method

- a. The test method for uranium will follow the ASTM D5174 Standard. This test method for trace uranium in water uses Pulsed-Laser Phosphorimetry analyzed by a KPA (Kinetic Phosphorescence Analyzer). This analyzer achieves highly specific analysis for uranium down to 0.01 µg/L with an analytical range of over 500,000 µg/L.
- b. The third party assay laboratory will be a NELAC-certified laboratory that will use a KPA system or other method(s) with detection capabilities sufficient to reliably detect down to 0.01 µg/L.

APPENDIX A



DOWEX 21K 16/20

A High Efficiency, Large Bead, Strong Base Anion Exchange Resin for Mineral Processing Applications

Product	Type	Matrix	Functional group
DOWEX® 21K 16/20	Type I strong base anion	Styrene-DVB, gel	Quaternary amine

Guaranteed Sales Specifications		Cl ⁻ form
Total exchange capacity, min.	eq/L	1.2
Bead size distribution		
Thru 20 mesh, max.	%	10
Thru 25 mesh, max.	%	2

Typical Physical and Chemical Properties		Cl ⁻ form
Water content	%	50 - 58
Whole uncracked beads	%	90 - 100
Total swelling (Cl ⁻ ⇒ OH ⁻)	%	20
Particle density	g/mL	1.08
Shipping weight	g/L	690
	lbs/ft ³	43

Recommended Operating Conditions

- Maximum operating temperature:
 - OH⁻ form 60°C (140°F)
 - Cl⁻ form 100°C (212°F)
- pH range 0 - 14
- Bed depth, min. 800 mm (2.6 ft)
- Flow rates:
 - Service/fast rinse 5 - 50 m/h (2 - 20 gpm/ft²)
 - Backwash See figure 1
 - Co-current regeneration/displacement rinse 1 - 10 m/h (0.4 - 4 gpm/ft²)
- Total rinse requirement 3 - 6 Bed volumes
- Regenerant:
 - Type NaCl/Carbonate
 - Temperature Ambient or up to 50°C (122°F) for silica removal
- Organic loading, max. 3g KMnO₄/l resin

Typical properties and applications

DOWEX 21K 16/20 type I strong base anion resin has excellent kinetics, excellent regeneration efficiency and outstanding physical stability. This enhanced-porosity gel bead product is made by a special process giving enhanced resistance to organics and fast equilibrium rates. The DOWEX 21K family of resins is specially suited for mineral processing and groundwater remediation applications. DOWEX 21K 16/20 type I strong base resin is suited for fluidized-bed and Resin-in-Pulp applications.

Packaging

5 cubic foot fiber drums

Figure 1. Pressure Drop vs. Flow Rate

For DOWEX 21K Resins, Cl, 77 deg. F

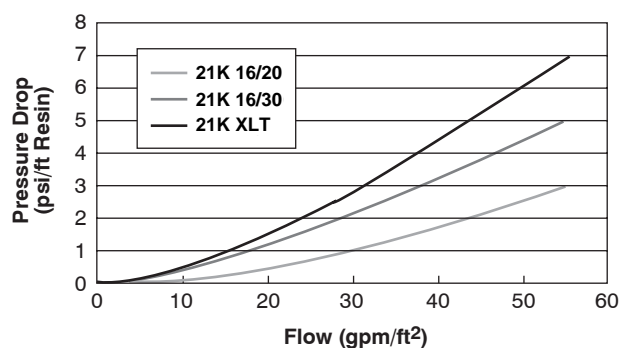
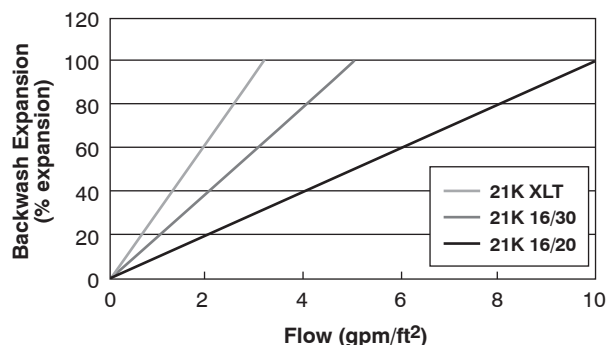


Figure 2. Backwash Expansion vs. Flow Rate

For DOWEX 21K Resins, Cl, 77 deg. F



DOWEX Ion Exchange Resins

For more information about DOWEX resins, call the Dow Liquid Separations business:

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<http://www.dowex.com>

Warning: Oxidizing agents such as nitric acid attack organic ion exchange resins under certain conditions. This could lead to anything from slight resin degradation to a violent exothermic reaction (explosion). Before using strong oxidizing agents, consult sources knowledgeable in handling such materials.

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