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March 31, 2011
File: 2499.4

New York State Department of Environmental Conservation
Bureau of Resource Management & Development
Division of Mineral Resources
625 Broadway, Third Floor
Albany, NY 12233-6500

Attention: Mr. Matthew Podniesinski
Chief, Resource Development Section
Bureau of Resource Management & Development

Subject: Annual Report Review - 2010
Cayuga Mine, Cargill, Inc.
Seneca and Tompkins Counties, New York

Gentlemen:

On December 30, 2010, Mr. Matthew Podniesinski, Chief, Resource Development Section, Bureau of Resource Management & Development, Division of Mineral Resources, New York State Department of Environmental Conservation (NYSDEC), received the Annual Report[1] from Cargill Deicing Technology (Cargill). John T. Boyd Company (BOYD) received a letter[2] from Mr. David Plumeau on January 31, 2011. Supporting information for this Annual Report on CD was received on February 3, 2011. This CD included electronic copies of maps as AutoCAD® files,

[1] Cargill Deicing Technology, 2009, "Annual Report for Mine File #709-3-29-0052; Cayuga Salt Mine, Permit ID#0-9999-00075-00001, Towns of Lansing and Ulysses, County of Tompkins, Town of Covert, County of Seneca," from Russell Givens to Matthew Podniesinski of NY Bureau of Resource Development Section.

[2] Plumeau, David, 2010, untitled letter to Vincent A. Scovazzo, John T. Boyd Company, January 29.

extensometer and closure readings, and consultant reports from Rock Mechanics Assist (RMA)[3,4], RESPEC[5,6,7].

On February 15, 2006, Mr. Steven M. Potter, Director, Bureau of Resource Management & Development of the New York State Department of Environmental Conservation (NYSDEC), requested that BOYD review all documents, digital data, and annual reports received by BOYD starting with the 2006 Annual Report.

The documents were reviewed for their adherence to conditions of the Permit[8] and in regard to discussions held at the Cayuga Mine among NYSDEC, Cargill, and BOYD on September 18, 2010. The Cargill 2010 Annual Report is accepted; however, the report did not include the following maps:

- Cargill Deicing Technology, 2008, "Cayuga Mine Closure (Inches) Sep-2009," showing closure of the 6 Level as file; "Cayuga Mine Contour2009 Closure Sep-2009."

- Cargill Deicing Technology, 2008, "Cayuga Mine Closure Rate (Inches/Year) Sep 2009," showing closure of the 6 Level as file; "Cayuga Mine Contour2009 Rate Sep-2009."

Discussion of Annual Report

The Annual Report submitted by Cargill is in response to special conditions 7 through 13 of Permit Number 0-9999-0075/00001. These special conditions and Cargill's responses are summarized below:

Special Condition 7—requires Cargill to submit an Annual Report, which is required to include items "a" through "g" of Special Condition 7.

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[3] Rock Mechanics Assist, 2010, an untitled letter from Gary Petersen to Dave Plumeau of Cargill Deicing Technology, August 24.

[4] Rock Mechanics Assist, 2010, an untitled letter from Gary Petersen to Dave Plumeau of Cargill Deicing Technology, April 17.

[5] RESPEC Engineering, 2010, "Additional Results of the 2006 Cayuga Mine Stability Assessment For Mohr-Coulomb Factor of Safety in the Nonsalt Beds," from Kerry L. DeVries to David Plumeau, December 23.

[6] RESPEC Engineering, 2011, "Task 2: Revised Geomechanical Study of Asymmetric Mains at Cayuga Mine," External Memoranda from Marc C. Loken to David Plumeau, January 14.

[7] RESPEC Engineering, 2011, "Task 3: Revised Northern Reserves Mine Design Analysis," External Memoranda from Marc C. Loken to David Plumeau, January 14.

[8] New York State Department of Environmental Conservation, Division of Environmental Permits, Region 7, 2003, "Permit" DEC Permit # 0-9999-00075/00001, expiration December 31, 2007, January 6.

Special Condition 7.a.—requires the inclusion of the Mine Manager's signed certification that "all mining related activities…were in conformance with this permit and the approved plans, or that variances have been reported and managed."

A certification was included on page 1 §13.a.1. dated December 29, 2010.

Special Condition 7.b.—requires "A summary of all non-routine mining incidents as defined in Special Condition 8. …" Special Condition 8 defines non-routine as "incidents during mining, processing, or other mine related activities that may adversely affect mine stability, ground and surface water or other natural resources, or the health, safety, welfare or property of the general public." Special Condition 9 expands on Special Condition 8 by requiring Cargill to submit "all correspondence with the Mine Safety and Health Administration involving non-routine mining incidents…". During a meeting held on August 17, 2004, with Cargill, NYDEC, and BOYD, it was agreed that statements will be included in the Annual Report "to point out known, encountered, or discovered geologic and geotechnical anomalies and mine action to address such anomalies."

Cargill included a statement in the Annual Report page 1, Section 13.a.2 that "[t]he Cayuga Mine is not aware of any non-routine incidents …" that would affect mine stability, ground and surface water, natural resources, and the general pubic. Noting that "[o]n occasion … rock structures … delay or hinder our mining plan" and it " ... continues to encounter a rock formation when mining to the east from the southern development (E-6 and E-7)."

RESPEC[5] addressed the mine stability below this anomaly by reviewing their previous work completed in 2006[9], which assessed thin or eroded carbonate layers. The conclusion was that the shale below the 4A Salt will fail and that the Bertie Formation potential for failure will increase as mining progresses north. BOYD notes that the non-salt beds were modeled as Mohr-Coulomb. However, strength of rock under confinement would not be linear resulting in the approach to failure being more plastic. Shale under these conditions would have a tendency to deform before failure. Thus, in BOYD's view, this was a conservative assessment.

RESPEC[6] addressed the placement of the mains below the anomaly. Two scenarios were examined: to have the mains 2,100 ft off panel center or 3,850 ft off center. RESPEC concluded that both scenarios resulted in similar behavior but the second scenario resulted in less closure and subsidence.

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[9] DeVries, K.L., P.E. Nelson, L.L. Sambeek, and W.M. Goodman, 2007, "Mine Stability Assessment, Cargill Deicing Technology, Cayuga Mine," RSI-1913, RESPEC, for Cargill Deicing Technology.

RESPEC[7] also addressed four panel configurations:

1. Yield pillars in a 500-ft-wide panel and 300-ft barriers,
2. Yield pillars in 300-ft-wide panel and 500-ft barriers,
3. Conventional pillars with a barrier, and
4. Conventional pillars without a barrier.

RESPEC recommended configuration 4 because it increases the strength of the area due to reduced extraction percentage, less closure, and greater stability of non-salt layers. The selection of configuration 4 over 3 was based on increased recovery. BOYD considers not having barriers as poor practice, as barriers offer protection for the rest of the mine in case wide-spread pillar failures occur.

RMA[3] addresses the anomaly by looking at the thinning carbonate area within three panels: U56, U58, and U60. RMA notes, "In summary there is no indication from the panel closure measurements that the area of interest has greater closure due to a weaker bridging beam." However, BOYD views the RMA data as proving the opposite, even when considering the effects of three-entry breakthroughs.

Part of this consideration is that the ESG Canada micro-seismic data points to movement in the thinning carbonate area. BOYD's present view of mining below the thinning carbonate is that Cargill should proceed using the RESPEC recommendations but incorporate barrier pillars. The stability of the area is not guaranteed, but with the constant monitoring of conditions using closure and micro-seismic monitoring, Cargill and its consultant should be able to ascertain developing adverse conditions.

Special Condition 7.c.—requires "[a]n updated Mining Plan Map depicting the current extent of mining activities, and the proposed advancement of the working face for the subsequent three years." At the August 2004 meeting, it was agreed that in addition "[a] mine map showing instrumentation location and type and shore line…" will be included in the Annual Report.

Mine maps as AutoCAD files were supplied by Cargill to fulfill this condition. All AutoCAD maps supplied were overlays and a base map. The base map was included as basemap with rock layer roof rock floor rock rolls.dwg, which was created on January 27, 2011 and includes a map entitled "Cayuga Mine, 6 Level Workings," by Cargill Deicing Technology. Also included on this map are roof and floor rolls as of December 31, 2010. Other maps provided are:

- The AutoCAD file; Complete Mine Overlay w Surface Subsidence.dwg, created January 27, 2011, containing Cargill Deicing Technology, 2009, "Complete Mine Overlay Map, Cayuga Mine, 6 Level Workings," which shows subsidence monument locations, shore line, and the 6 Level.

- The AutoCAD file; 3 YR MINE PLAN 10-11 2 north - 2 south (updated12-21-10md).dwg, created January 27, 2011, containing the map Cargill Deicing Technology, 2010, "Cayuga Mine, 3 YR Planning Map, 2010/2011 Fiscal Yr." This map shows planned expansion through fiscal year 2013–2014.

- The AutoCAD file; ROYALTY.dwg, created January 27, 2011, containing the map Cargill Deicing Technology, 2011, "Cayuga Mine, Mine Royalty Map, 2010/2011 Fiscal Yr." January. Map shows fiscal year production areas from 6/1/84 through 12/31/10.

- The AutoCAD file; U-40B backfill.DWG, created January 27, 2011, containing the map "Backfill Map – U40B." Map shows filled area and areas "to be filled next" for U40, U40A, U42, U44W, U44E, and U46W.

- The AutoCAD file; 4 Level Pond Map MLRP Version 22Dec10.Dwg, created January 27, 2011, containing the map Cargill Deicing Technology, 2011, "Cayuga Mine, 4 Level Pond Map, Updated: 22 Dec 2010," January. This map shows filled levels to January 1, 2011, and remaining potential pond area.

- AutoCAD file; 4 Level Convergence Map.dwg, created January 27, 2011. This untitled and undated map shows closure station locations.

- The AutoCAD file; 4A Level for JT Boyd.dwg, created January 27, 2011, containing undated, "4A Level Instrumentation Map." This map shows closure stations locations.

- The AutoCAD file; W1_1 Tunnel 8 Door Insp to JT Boyd.dwg, created January 27, 2011, containing undated and untitled map. This map shows extensometer locations.

- The AutoCAD file; 20 Belt Area.dwg, created January 27, 2011, containing undated map "B-20 Belt Drift Mined in 1984." This map shows extensometer locations.

- A hard copy map; undated and untitled, scale 1" = 50' and AutoCAD file; PAMELPASS.DWG, created January 27, 2011, contains the map "4 Level, Pamel Pass – 13 Belt." Map shows locations of extensometers along 13 belt.

- An untitled AutoCAD file; Screen Plant Horizontal Roof Ext.dwg, created January 26, 2011, showing map and cross-section view of installation locations of near horizontal extensometers in the roof of the screen plant gallery.

- The AutoCAD file; Screen Plant Instrumentation.dwg, created January 27, 2011, containing map undated, "Unit # 5 Screenplant," showing instrument locations in and around the screen plant gallery.

- The AutoCAD file; U31 Powder Mag 2009.dwg, created January 27, 2011, containing map undated, an untitled and undated map showing instrument locations in and around the powder magazine.

- The AutoCAD file; undated, "Current Surge Bin Instrumentation Map as of 9-09" and AutoCAD file; Surge Bin instrument Map to JT Boyd.dwg, created January 27, 2011, containing undated, "Current Surge Bin Instrumentation Map as of 9-09," showing instrument locations in and around the screen plant gallery.

- AutoCAD file; Convergence Map w-Basemap Outline 2010.dwg, created January 27, 2011, containing the Map Cargill Deicing Technology, undated, "Cayuga Mine, 6 Level Workings." This map shows the locations of convergence stations.

The supplied maps show the extent of mining, proposed mine plan, subsidence monument locations, shorelines of both the 4 Level flooding and of Cayuga Lake, and instrument locations and movements. However, maps illustrating recorded mine closure for the reporting period were not provided. Similar type maps received in the past were:

- Cargill Deicing Technology, 2008, "Cayuga Mine Closure (Inches) Sep-2009," showing closure of the 6 Level as file; "Cayuga Mine Contour2009 Closure Sep-2009."

- Cargill Deicing Technology, 2008, "Cayuga Mine Closure Rate (Inches/Year) Sep-2009," showing closure of the 6 Level as file; "Cayuga Mine Contour2009 Rate Sep-2009."

Special Condition 7.d.—requires the annual report to include a "summary of in situ measurements of rock mechanics required by Special Conditions 12." Special Condition 12 requires the measurement and collection of in situ rock mechanics data "in accordance with the approved Mined Land Use Plan." The data is to include "plots of relevant graphs. ..." Furthermore, "[e]xceptions to anticipated trends in rock behavior shall be noted and explained. ..."

At the August 2004 meeting, it was agreed that "[a]ll rock mechanics data" would be incorporated in the Annual Report, "including, but not limited to, all instrumentation readings and observations from the initial readings to present. Data for subsidence, closure, and extensometers are to be provided electronically. These electronic files are to include raw and processed data, graphs, and explanations of any inconsistencies and anomalous readings including reasons for abandonment, reinstallation, etc., along with applicable observation in the vicinity of the instrument such as floor heave, water inflow, etc. Future reports are to contain comment on whether, in the opinion of Cargill, the instrument readings support or conflict with prior stability models especially in areas employing new mine, panel, or main configurations."

Closure measurements can be evaluated to indicate possible instability in three ways:

1. By studying the graphs of the rate of closure over time. The shape of these graphs indicates areas of instability, areas of concern, and areas of stability. Mr. Petersen of RMA (Cargill geotechnical consultant) evaluated the closure in this manner.

2. By establishing trigger values for total closure. This method is applicable in harder, less viscous rock but is not applicable for the Cayuga Mine, as stable closure in salt will continue until the openings are closed.

3. By establishing trigger values for long-term closure rates. Since this is not being completed by the other investigators, BOYD applied such trigger rates in its evaluation of the closure readings.

Closure rate data are significant because they offered insight into the collapses and the inundation of the Retsof Mine. Sustained closure rates of 15 in. per year or less were measured in stable areas of the Retsof Mine, while in the failure areas, closure was regularly measured with sustained rates over 230 in. per year with onset of failure around 600 in. per year. Although Retsof and Cayuga mines have different overburden and material properties, in the general sense, a comparison seems warranted for a relative indicator of stability.

In BOYD's review of the closure stations readings for 2010, it was noted that none of the readings exceeded 230 in. per year. Below is a list of the 10 highest measured closure rates in 2010 for areas of recent mining defined as areas within 1,000 ft of mining that occurred in 2009 or 2010.

Top 10 Closure Rates in Areas of Recent Mining

Closure Station	Rate of Closure (in./yr)	Last Recorded Rate of Closure (in./yr)	Notes
U58PIN#37	98.55	2.50	Initial Reading
U60PIN#17	86.51	12.71	Initial Reading
S3PIN#56	82.49	11.68	Initial Reading
U58PIN#35	73.05	9.65	Initial Reading
U60PIN#19	69.97	8.03	Initial Reading
U58PIN#38	68.05	0.82	Initial Reading
S3PIN#52	65.88	6.24	Initial Reading
S3PIN#55	63.60	17.10	Third Reading
S3PIN#57	62.85	7.93	Initial Reading
E5PIN#8	62.51	0.67	Initial Reading

Also determined are the top 10 closure rates away from mining.

Top 10 Closure Rates Away from Recent Mining

Closure Station	Rate of Closure (in./yr)	Last Recorded Rate of Closure (in./yr)	Notes
U12PIN#101	11.50	0.51	Reset, installed permanent rod
U12PIN#32	1.88	1.16	Installed permanent rod
U54PIN#17	1.87	0.52	Installed permanent rod
NW2PIN#38	1.77	1.14	
U59PIN#5	1.69	0.48	Installed permanent rod
W1PIN#7A	1.62	0.48	Installed permanent rod
NW2PIN#37	1.56	0.91	Gauge stuck, installed permanent rod
U54PIN#5A	1.53	0.37	Installed permanent rod
U54EPIN#5	1.50	0.38	Installed permanent rod
NW2PIN#33	1.49	error	Reset rod

Many of the readings in the list are the resultof the introduction of error due to installing permanent rods or by the instrument's involvement with a mishap. Closure rates throughout the mine are slow. This indicates the mine's global stability. In the past, the closure rates at U-40B panel (the fill area) were considered separately from the top 10 readings since it is being filled due to instability. However, the closure rates in this area are now less than any rate noted in the top 10, showing that this area is now stabilizing. Cargill also notes this occurrence in the Annual Report (Section 13.a.4); "Since backfill placement in the U40B area has been completed the convergence rates have slowed and are trending back toward historical rates." RMA[4] also noted this event: "Closure rates in the U40B area are on the decline… . Notice that the rates began to increase in 2007, peaked in 2008, and are now decreasing."

Cargill also noted in Section13.a.4, "The U-12 panel also shows higher than normal closure near the breakthrough with SW-2 and near the U-12A sub-panel." Only two of these readings are included in the list of 10 highest readings and both of those show a decreasing trend. This may indicate that stability is improving in this area. RMA[4] also notes this: "There are two areas in Panel 12 which are showing higher than expected closure rates … . Both areas involve intersecting panels at U12/SW2 and U12/U12A."

Two closure stations were monitored on 4 Level and have closure rates of 0.255 to 0.493 in. per year and three closure stations were monitored on 4A Level and ranged from 0.111 to 0.333 in. per year. BOYD offers the following comments:

- Closure readings for recently mined areas are typically high. The highest of these readings near active mining was concentrated in two production areas, with five in the U58 and U60 area and five in the S3 and E5 area. All of the 10 stations show dramatic reduction over time, indicating the ground is stable or is stabilizing.

- Seven of the ten highest closure rates away from active mining were concentrated in the U54 and U59 intersection with NW54. Two were located in U12.

Extensometer data was also evaluated and a top 10 list was developed based on expansion rate of the third Rod. A measurement of 1 in. per year is often accepted as a convenient point in examining extensometer data, as this value is close to, but normally less than, the value required for bed separation (opening of bedding planes). Thus, none of the extensometer readings were alarming.

Top 10 Extensometer Rates

Extensometer Location	Station	Rod 1, in/yr	Rod 2, in/yr	Rod 3, in/yr
Sreen Plant Pillar	SP-H Pillar-Ahole-1tun	0.110	0.183	0.329
Sreen Plant Pillar	SP-G Pillar-Bhole-1tun	0.073	0.183	0.292
Sreen Plant Pillar	SP-H Pillar-Ahole-3tun	0.037	0.073	0.292
Sreen Plant Horizontal	SP HR - 4B	0.000	0.000	0.292
Roof	20 belt 7C	0.256	0.256	0.256
Sreen Plant Pillar	SP-J Pillar-Bhole-1tun	0.037	0.183	0.219
Sreen Plant Horizontal	SP HR - 4A	-0.037	0.000	0.219
Roof	20 belt 3C	0.219	0.219	0.183
Roof	Pamel Pass #5	0.110	0.146	0.146
Sreen Plant Pillar	SP-I Pillar-Bhole-1tun	0.037	0.146	0.146

In the 2009 Annual Report, Cargill noted that they have upgraded "...the microseismic monitoring system to digital format, doubled the number of geophones, and doubled the area being monitored." In the 2010 Annual Report, a series of reports as ESG Canada Inc., 2010, "Remote Data Processing Seismicity Report, Cayuga Mine," Kingston, Ontario, included:

- January 1st – 31st, March 22.
- February 1st – 28th, March 26.
- March 1st – 31st, April 1.
- April 1st – 30th, May 10.
- May 1st – 31st June 1.
- June 1st – 30th, July 2.
- July 1st – 31st August 6.
- August 1st – 31st, September 27.
- September 1st – 30th, October 26.

- October 1st – 31st, November 4.
- November 1st – 30th, December 6.
- December 1st – 30th, January 10, 2011.

A brief overview of these reports shows that seismic events favor areas west of the mains, production areas, and areas of thinning rock in the northern part of the mine. A discussion with Cargill on the significance and use of this data is needed.

Special Condition 7.e.—requires the Annual Report include a "summary of subsidence monitoring data required by Special Condition 11." Special Condition 11 requires "[s]ubsidence monitoring shall be conducted in accordance with the approved subsidence monitoring plan contained within the approved Mine Land Use Plan." Furthermore, "[e]xceptions to the trends shall be noted and explained…". Points applicable to Special Condition 7.e. were agreed upon at the August 2004 meeting and are noted above under Special Condition 7.d.

BOYD, in its 2007 annual review, examined the last presented subsidence data discussed in the 2008 Annual Report. These measurements were completed in December 2007, concluding that this data supported an option that the mine is stable.

Section 13.a.5 of the Annual Report noted that "[n]o subsidence surveys were conducted this year."

Special Condition 7.f.—requires the inclusion of "[i]nformation regarding the source and volume of any water inflow into the mine, and the disposition of such water." At the August 2004 meeting, it was agreed that a discussion about water disposal in 4 Level would be included in the Annual Report, noting: "Updates of Level 4 filling including data on shore line advance."

Cargill reported the total water inflow to 4 Level was 8,894,769 gallons, down from 10,401,624 gallons in 2010, the fifth year of decline. With this lower inflow, Cargill estimates that 21.1 years of storage remain on 4 Level. Cargill included a 4 Level pond map, as noted above, and an Excel file, UG Pond Volume Calculation 22Dec10.xls, which was created on December 28, 2010.

Special Condition 7.g.—requires the inclusion of "[a] summary of all other monitoring data required under the terms of this permit or Department SPDES permit issued to Cargill."

SPDES data and a discussion of this data are included in the Annual Report. This data is to be reviewed by NYSDEC.

Special Condition 8—addresses non-routine incidents and is discussed under Special Condition 7.b.

Special Condition 9—addresses Mine Safety and Health Administration reporting involving non-routine mining incidents and is discussed under Special Condition 7.b. Cargill includes a statement on section 13.c. of the Annual Report that "[t]he Cayuga Mine has not received any citations from MSHA regarding non-routine mining incidence, but does not note reports or letters from MSHA concerning any non-routine mining incidents."

Special Condition 10—addresses reporting requirements "Prior to undertaking any material change in the approved mining methods or techniques. ..." This condition does not require the reporting to occur in the Annual Report.

Cargill notes, "There have been no changes to the Cayuga Mine layout in the past year."

Special Condition 11—addresses subsidence monitoring, as discussed under Special Condition 7.e. above.

Special Condition 12—addresses rock mechanics monitoring, as discussed under Special Condition 7.d.

Special Condition 13—addresses the reporting and recording of citizen complaints. Cargill notes in the Annual Report that "no written citizen complaints" were received.

Site Visit

A site visit to discuss these findings with NYSDEC, Cargill, and BOYD should be arranged. Suggested areas to visit in the mine are intersections at U12/SW2 and U12/U12A.

Discussions at this meeting should include a brief overview of the seismic reports and the significance and use of this data.

Please contact us if you require additional information or if we may be of further service.

Respectfully submitted,

JOHN T. BOYD COMPANY
By:

Vincent A. Scovazzo
Director of Geotechnical Services

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