NM2 - 7

MONITORING REPORTS YEAR(S):

1995-1997

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

November 7, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period October 1, 1997, to October 31, 1997, for the project entitled "Small-Scale Demonstration of the Freeze–Thaw/ Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters." I have also included a cost versus time graph for the project and disk copy of the report, prepared in WordPerfect® Version 6.1.

If I can provide any additional information relating to the New Mexico FTE℠ demonstration, please feel free to give me a call at (701) 777-5158 or e-mail at agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Research Associate

AAG/djs

Enclosure

c/enc: Thomas Hayes, GRI
John Harju, GRI
Mildred Perry, FETC–Pittsburgh
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Deborah Johnson, EERC

MJK 11-19-97

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters

October 1, 1997 – October 31, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

November 7, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE–THAW/EVAPORATION (FTE℠) PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 – Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 – Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996–1997. Site modifications were completed in the second week of December 1996. Construction of the FTE℠ process plant has also been completed.

Task 3 – Operation of the FTE℠ Process – Evaporation

- The evaporation work is complete. Data reduction and analysis are under way.

Task 4 – Operation of the FTE℠ Process – Freezing

- Detailed organic and inorganic analysis on feed, brine, and treated water samples are completed.

- All data collected on-site during FT operations and all detailed chemical analysis of feed, brine, and treated water samples have been tabulated.

Task 5 – Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids from TDS analyses are being analyzed for their constituents.

- Potential beneficial uses for the brine have been identified.

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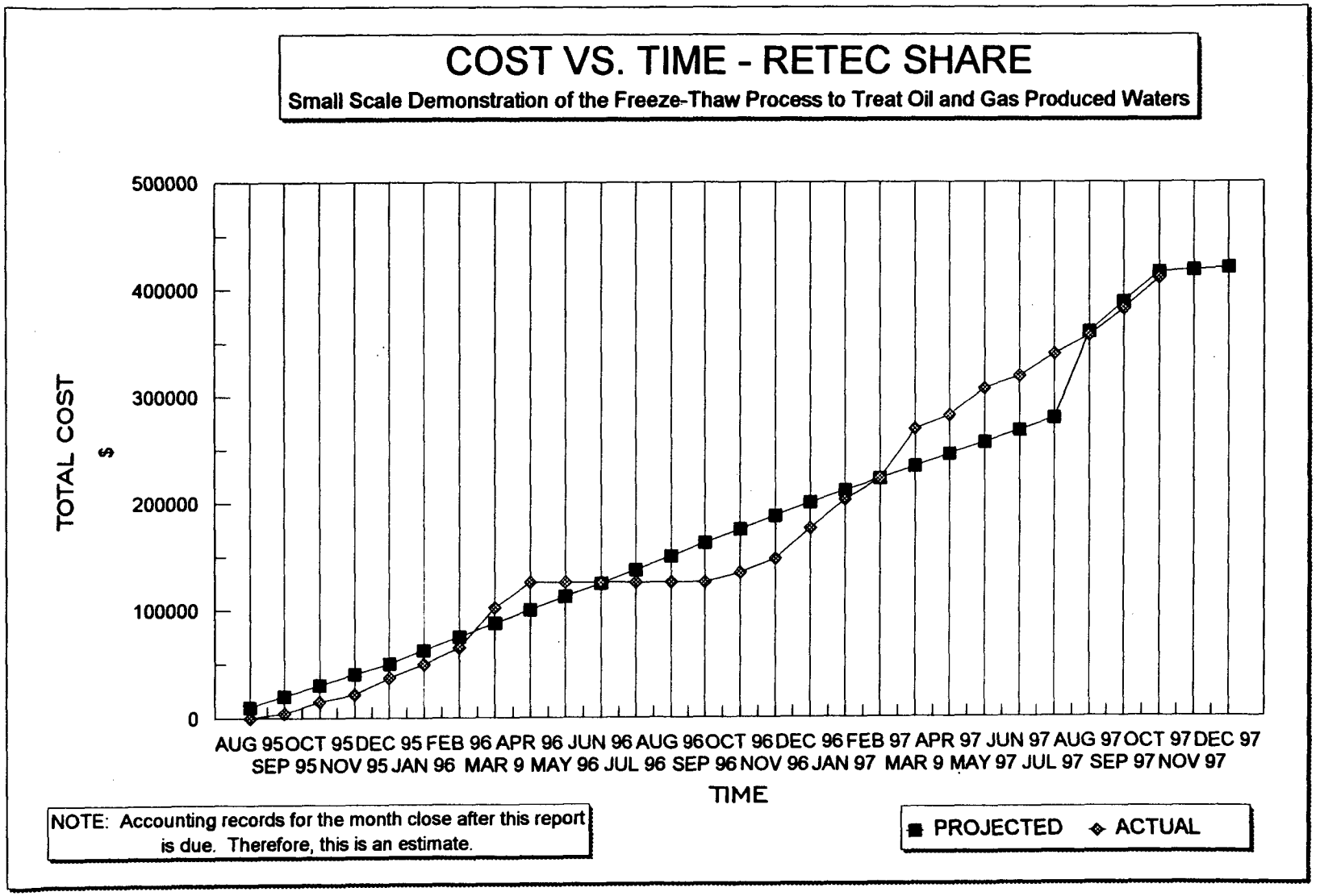

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

October 14, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period September 1, 1997, to September 30, 1997, for the project entitled "Small-Scale Demonstration of the Freeze–Thaw/ Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and disk copy of the report, prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE℠ demonstration, please feel free to give me a call at (701) 777-5158 or e-mail at agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/djs

Enclosure

c/enc: Thomas Hayes, GRI
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John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze–Thaw/Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters"

September 1, 1997 – September 30, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

October 14, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE–THAW/EVAPORATION (FTE℠) PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 – Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 – Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996–1997. Site modifications were completed in the second week of December 1996. Construction of the FTE℠ process plant has also been completed.

Task 3 – Operation of the FTE℠ Process – Evaporation

- Equipment for the evaporation study has been set up. Data are being collected on different modes of evaporation.

Task 4 – Operation of the FTE℠ Process – Freezing

- Detailed organic and inorganic analyses on feed, brine, and treated water samples are completed.

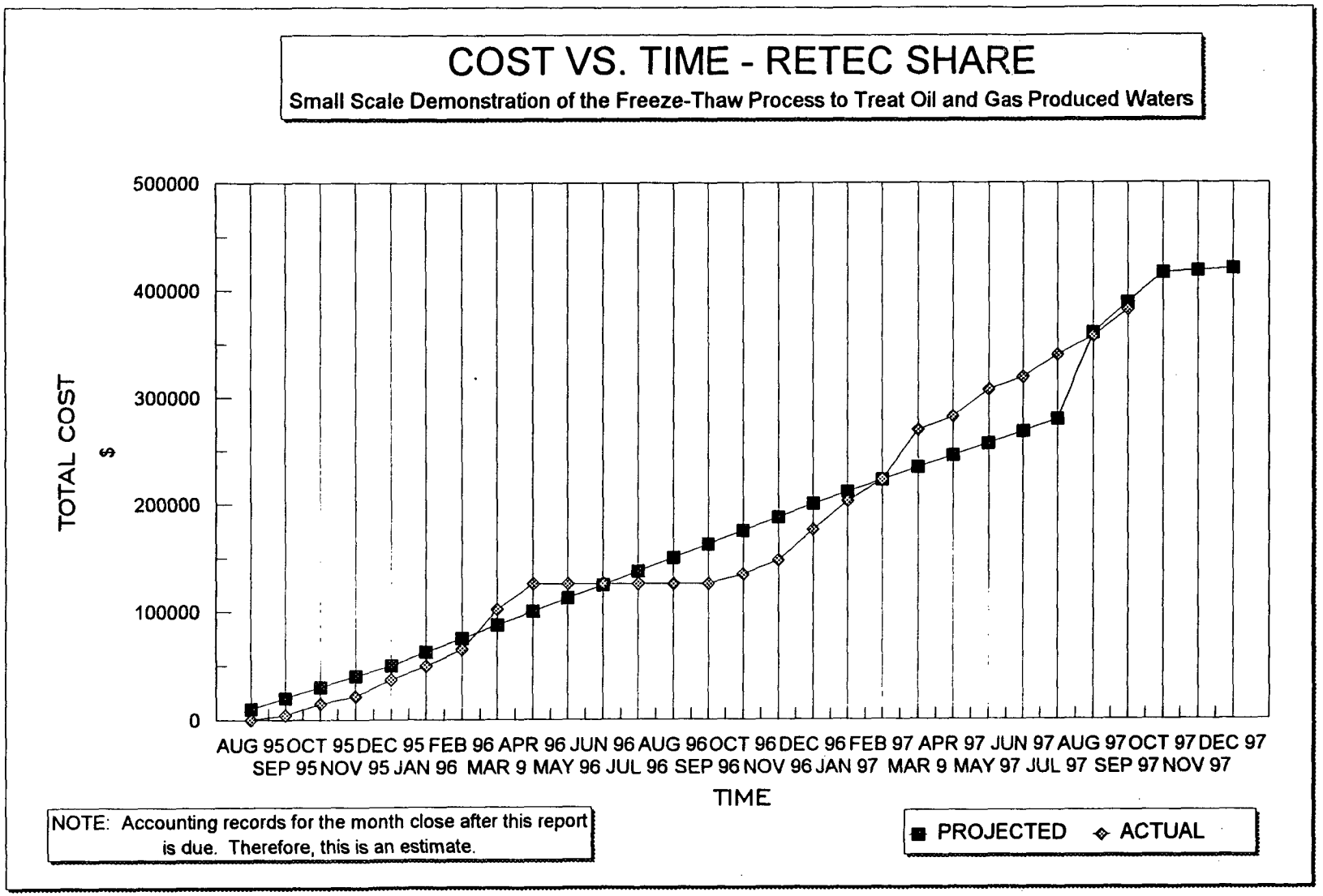
- All data collected on-site during FT operations and all detailed chemical analyses of feed, brine, and treated water samples have been tabulated.

Task 5 – Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids from TDS analyses are being analyzed for their constituents.

- Potential beneficial uses for the brine have been identified.

FILE: S:\SHEETS\JMM\REPORTS\GRAPHS\FUND 4822



Energy & Environmental Research Center
UNIVERSITY OF NORTH DAKOTA
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World Wide Web Server Address: www.eerc.und.nodak.edu

September 4, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Dear Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period August 1 - 31, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation (FTE^{SM}) Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and disk copy of the report prepared in WordPerfect Version 7.

If I can provide any additional information relating to the New Mexico FTE demonstration, please feel free to give me a call at (701) 777-5158 or e-mail agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Research Associate

AAG/jdk

Enclosure

c/enc: Thomas Hayes, GRI
John Harju, GRI
Susan Joines, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

Small-Scale Demonstration of the Freeze-Thaw/Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters

August 1 - 31, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

September 4, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION (FTE℠) PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 – Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 – Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996–1997. Site modifications were completed in the second week of December 1996. Construction of the FTE process plant has also been completed.

Task 3 – Operation of the FTE Process – Evaporation

- Equipment for the evaporation study has been set up.

Task 4 – Operation of the FTE Process – Freezing

- Detailed organic and inorganic analyses on feed, brine, and treated water samples are completed.

- All data collected on-site during freeze–thaw operations and all detailed chemical analysis of feed, brine and treated water samples have been tabulated.

Task 5 – Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids from total dissolved solids analyses are being analyzed for their constituents.

- Potential beneficial uses for the brine have been identified.

Other Notes:

A presentation will be given by John Boysen of B.C. Technologies on the results of the FTE℠ process freezing operations conducted during the last winter at the International Petroleum Environmental Conference in San Antonio, Texas, on 11 September 1997.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

August 4, 1997

AUG 11 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period July 1, 1997, to July 31, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and disk copy of the report, prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE℠ demonstration, please feel free to give me a call at (701) 777-5158 or e-mail to agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/mro

Enclosure

c/enc: Thomas Hayes, GRI
John Harju, GRI
Susan Joines, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters

July 1, 1997 - July 30, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

August 4, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997. Site modifications were completed in the second week of December 1996. Construction of the FTE^{SM} process plant has also been completed.

Task 3 - Operation of the FTE^{SM} Process - Evaporation

- A site for evaporation tests has been selected by Amoco.
- Initial planning of the evaporation study is complete.

Task 4 - Operation of the FTE^{SM} Process - Freezing

- Detailed organic and inorganic analysis on feed, brine, and treated water samples is completed.
- All data collected on-site during freeze-thaw (FT) operations and all detailed chemical analysis of feed, brine, and treated water samples have been tabulated.

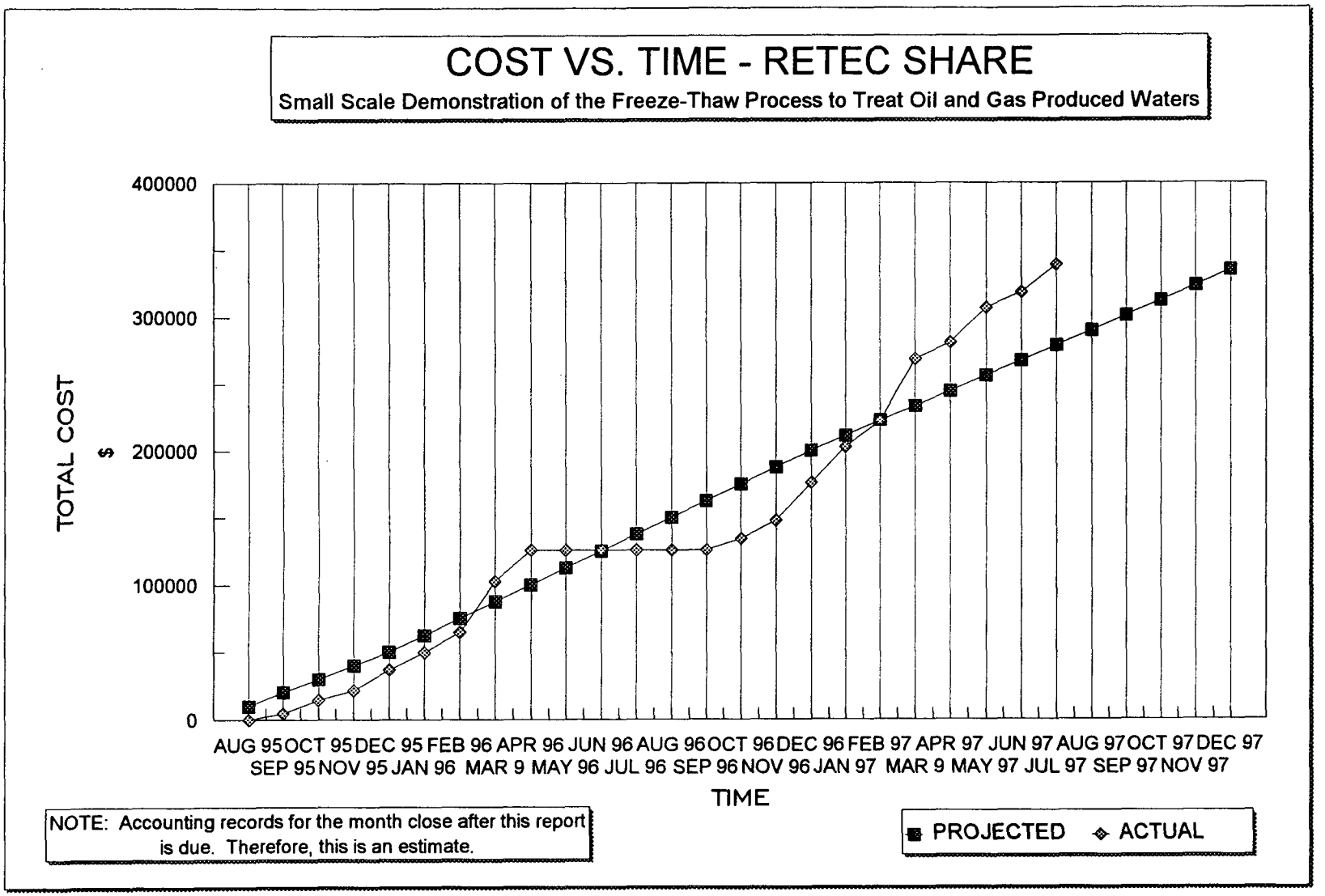
Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids from total dissolved solids analyses are being analyzed for their constituents.
- Potential beneficial uses for the brine will be identified and investigated.

Other Notes:

A presentation will be given on August 6 at the EERC to personnel from DOE FETC summarizing the FTE^{SM} field test.

FILE: S:\SHEETS\JMM\REPORTS\GRAPHS\FUND 4822



Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

July 2, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Mr. Lawrence:

Enclosed please find a copy of the monthly report for the period June 1, 1997, to June 30, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters." I have also included a cost versus time graph for the project and a disk copy of the report prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE℠ demonstration, please feel free to give me a call at (701) 777-5158, fax at (701) 777-5181, or e-mail at agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/djs

Enclosure

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Debby Johnson, EERC

mk

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation (FTE℠) Process to Treat Oil and Gas Produced Waters

June 1– June 30, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

July 2, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION (FTE℠) PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996–1997. Site modifications were completed in the second week of December 1996. Construction of the FTE℠ process plant has also been completed.

Task 3 - Operation of the FTE℠ Process - Evaporation

- A site for evaporation tests has been selected by Amoco.
- Initial planning of the evaporation study is complete.

Task 4 - Operation of the FTE℠ Process - Freezing

- Detailed organic and inorganic analyses on feed, brine, and treated water samples are completed.

- All data collected on-site during FT operations and all detailed chemical analyses of feed, brine, and treated water samples have been tabulated.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids for TDS (total dissolved solids) analysis are being analyzed for their constituents.

- Potential beneficial uses for the brine will be identified and investigated.

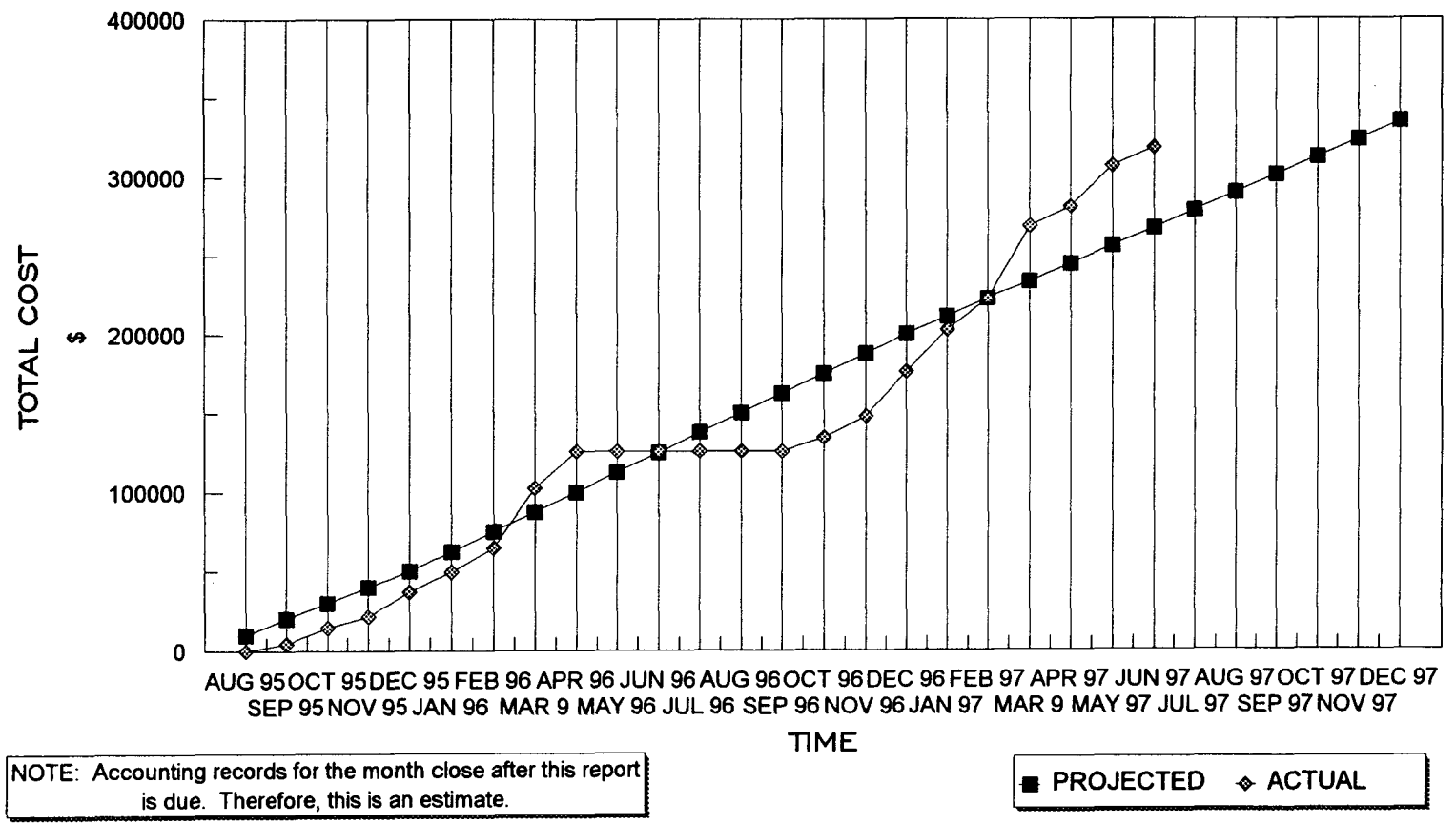
Other Notes:

A presentation will be given on August 6, 1997, at the Energy & Environmental Research Center to personnel from the U.S. Department of Energy Federal Energy Technology Center summarizing the FTE℠ field test.

FILE: S:\SHEETS\JMM\REPORTS\GRAPHS\FUND 4822

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street – PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

June 17, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period May 1, 1997, to May 31, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE℠ demonstration, please feel free to give me a call at (701) 777-5158 or e-mail at agrisanti @eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/csd

Enclosure

c/enc: Thomas Hayes, GRI
John Harju, GRI
Susan Joines, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

MJK 6/23/97

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

May 1, 1997 - May 31, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

June 17, 1997

"SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS"

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997. Site modifications were completed in the second week of December 1996. Construction of the FTE^{SM} process plant has also been completed.

Task 3 - Operation of the FTE^{SM} Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with GRI and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that, as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE^{SM} Process - Freezing

- Detailed organic and inorganic analyses on feed, brine, and treated water samples are completed.

- All data collected on-site during FT operations and all detailed chemical analysis of feed, brine, and treated water samples have been tabulated.

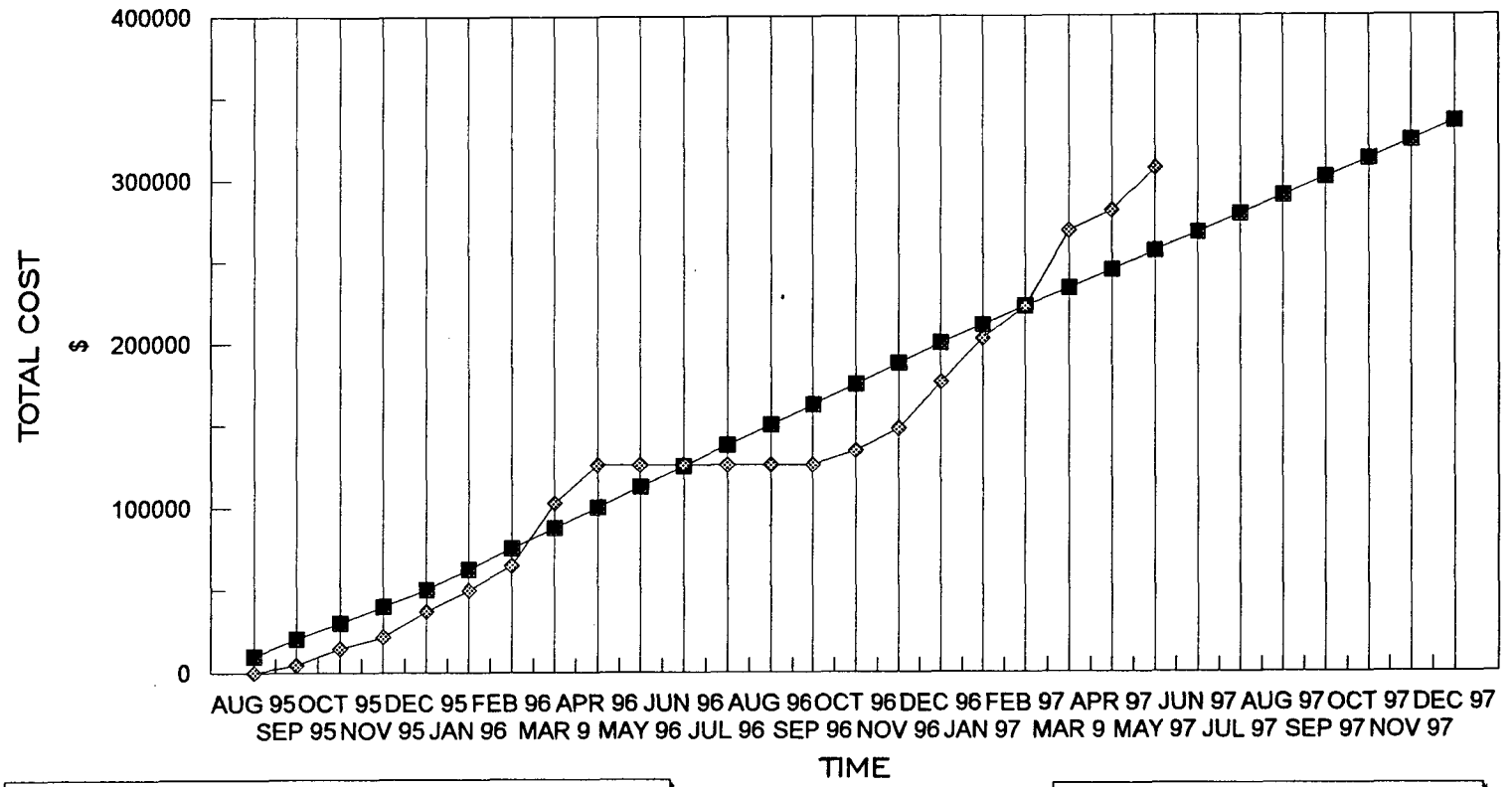
Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids from TDS analyses are being analyzed for their constituents.

- Potential beneficial uses for the brine will be identified and investigated.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Buddy:

ept to March 31, 97 for

Jorge Khan

Verbal approval

8/12/96

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

April 2, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Dear Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period March 1, 1997, to March 31, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost versus time graph for the project and a disk copy of the report prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico freeze-thaw/ evaporation (FTE^{SM}) demonstration, please feel free to give me a call at (701) 777-5158 or e-mail agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/djs

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Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters

March 1, 1997 - March 31, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
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Submitted by:

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GRI Agreement 5091-253-2215

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U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

April 2, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997. Site modifications were completed in the second week of December 1996. Construction of the freeze-thaw/evaporation (FTE^{SM}) process plant has also been completed.

Task 3 - Operation of the FTE^{SM} Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with GRI and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE^{SM} Process - Freezing

- Phase II freezing operations were concluded in late February.
- Laboratory analysis of feed, brine, and treated water samples was completed in late February.
- Data reduction activities for process data collected during freezing operations are under way.
- Automated sorting of the water from the melting ice using on-line conductivity controllers is operational.
- Samples of treated water are being collected from the ice melt as treated water is transferred to on-site storage tanks.
- Freeze-thaw operations are expected to be completed by 15 April 1997. Water samples are being submitted for detailed analysis.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January 1996. At this time, preliminary data suggest that there may be possible uses of the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from the winter of 1995-1996 on-site total dissolved solids determinations has been completed. Additional analytical data will be generated during

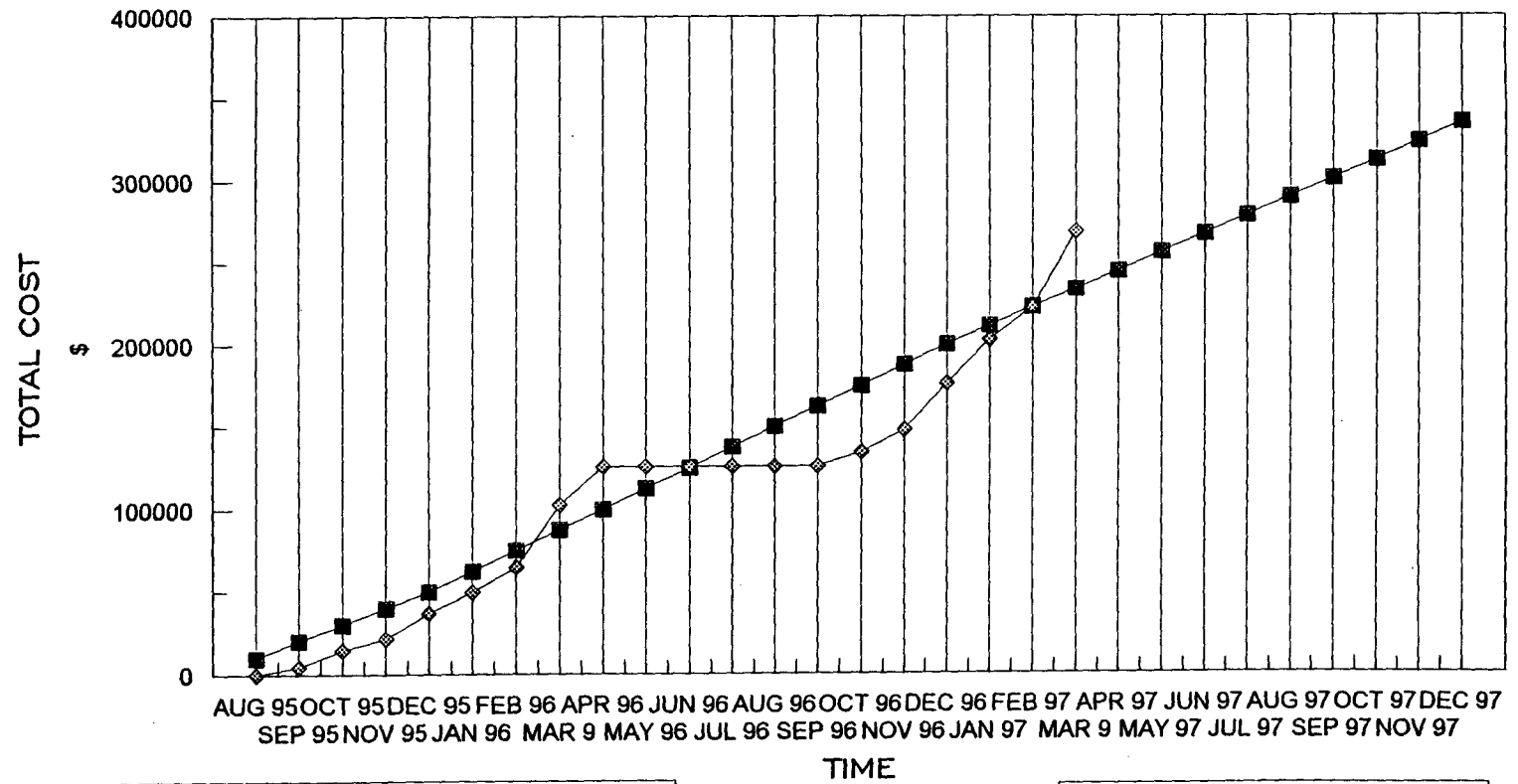
the winter of 1996-1997 and examined to provide further information regarding potential uses of the brine and/or solids produced.

Other Notes

- The balance of funding for this project still has not been received from RETEC. In order to continue operations to complete the evaporation phase of this work, we will need funds to be in place by June 1, 1997.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street - Stop 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

May 15, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Dear Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period April 1, 1997, to April 30, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and disk copy of the report, prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE demonstration, please feel free to give me a call at (701) 777-5158 or e-mail agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Research Associate

AAG/jmm

Enclosures

c/enc: Thomas Hayes, GRI
John Harju, GRI
Wu Lan, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters

April 1, 1997 – April 30, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

May 15, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997. Site modifications were completed in the second week of December 1996. Construction of the FTE process plant has also been completed.

Task 3 - Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with GRI and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Freeze-thaw operations were concluded 15 March 1997.
- Samples of feed water, treated water, and brine were submitted for detailed analysis.
- All data collected on-site during freeze-thaw operations have been tabulated and are under analysis.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Samples of brine and residual solids from total dissolved solids analyses are being analyzed for their constituents.

- Potential beneficial uses for the brine will be identified and investigated.

Other Notes:

- The balance of funding for this project has still not been received from RETEC. In order to continue operations to complete the evaporation phase of this work, we will need funds to be in place by June 1, 1997.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

March 11, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period February 1, 1997, to February 28, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation (FTE^{SM}) Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and disk copy of the report, prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE^{SM} demonstration, please feel free to give me a call at (701) 777-5158 or e-mail to agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Research Associate

AAG/djs

Enclosure

c/enc: Thomas Hayes, GRI
John Harju, GRI
Susan Joines, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

February 1, 1997 - February 28, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

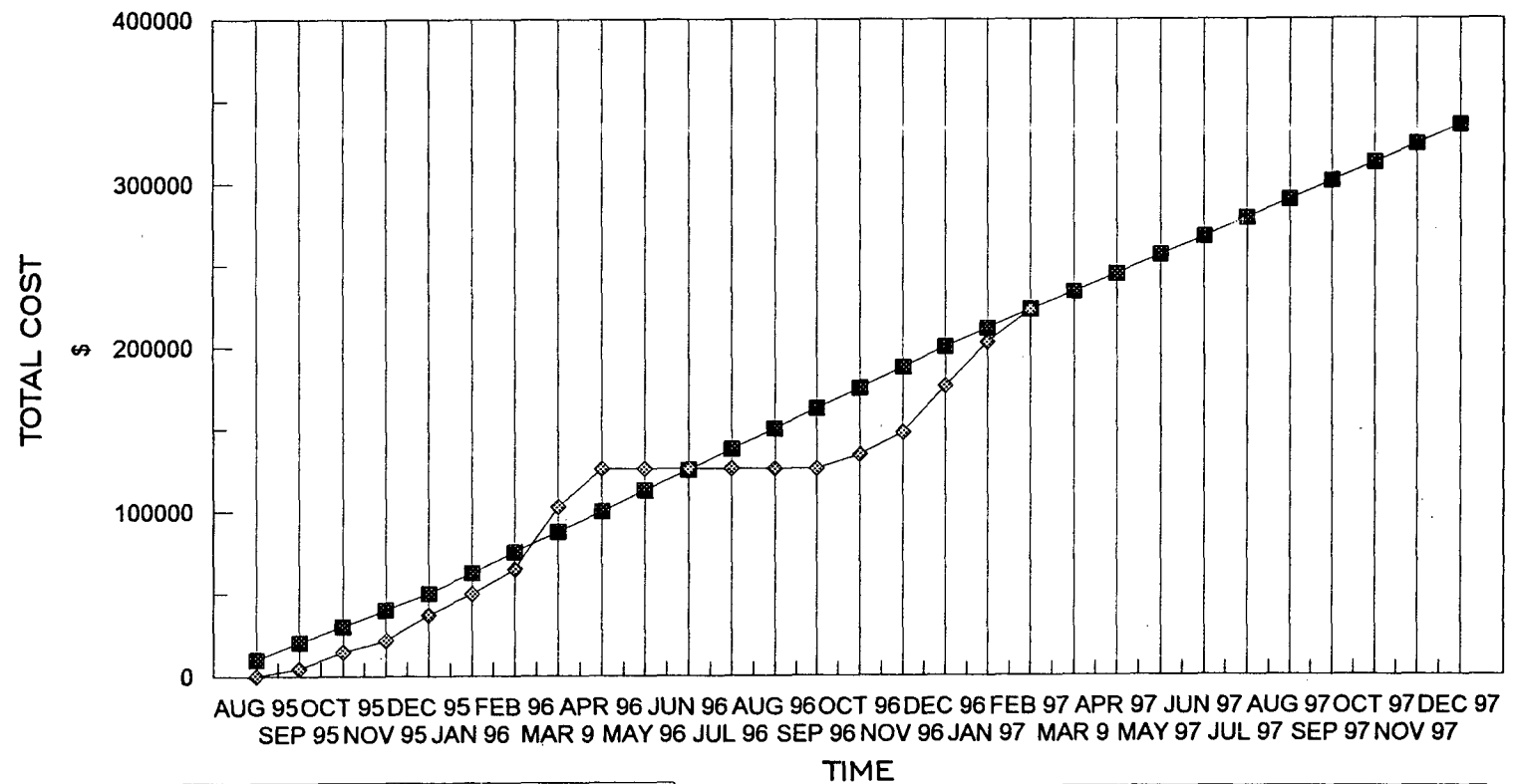
and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

March 11, 1997

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

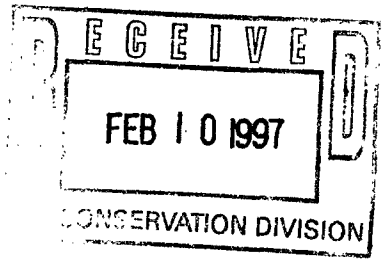
Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

February 4, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238



Dear Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period January 1, 1997, to January 31, 1997, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation (FTE) Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

If I can provide any additional information relating to the New Mexico FTE demonstration, please feel free to give me a call at (701) 777-5158 or e-mail at agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/csd

Enclosure

c/enc: Thomas Hayes, GRI
John Harju, GRI
Susan Joines, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

January 1, 1997 - January 31, 1997

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

February 4, 1997

"SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS"

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997. Site modifications were completed in the second week of December 1996. Construction of the FTE process plant has also been completed.

Task 3 - Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with GRI and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Phase II freezing operations began in early December and continued during January. Approximately 500 hours of plant operation were conducted at subfreezing conditions during December 1996 and January 1997.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January 1996. At this time preliminary data suggest that there may be possible uses of the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from the winter of 1995-1996's on-site total dissolved solids determinations has been completed. Additional analytical data will be generated during the winter of 1996-1997 and examined to provide further information regarding potential uses of the brine and/or solids produced.

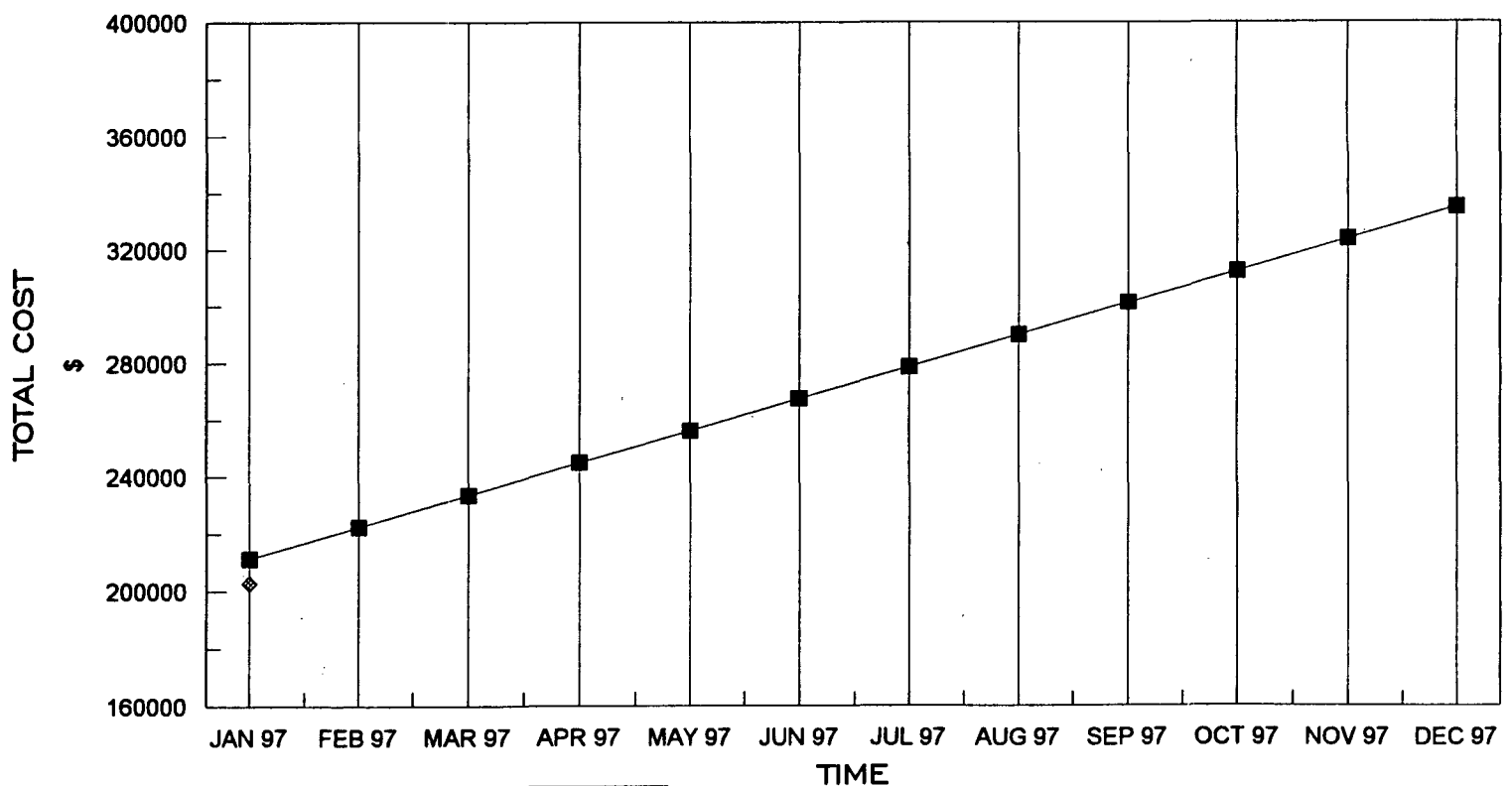
Other Notes

- Activation and testing of automated FTE plant operations were initiated in late January. Analysis of data collected on-site during the December 1996 through January 1997 is under way as of February 1, 1997.

- Composite feed, brine, and treated water samples will be submitted for detailed analysis early in February 1997.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

January 3, 1997

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Dear Mr. Lawrence:

Enclosed you will find a copy of the monthly report for the period December 1, 1996, to December 31, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

As you are aware, John Harju has left the Energy & Environmental Research Center (EERC) to take a position at Gas Research Institute. As a result of John leaving the EERC, I will be managing the freeze-thaw/evaporation (FTE) demonstration in New Mexico and all subsequent EERC projects involving application of freeze crystallization to water treatment with and without evaporation.

If I can provide any additional information relating to the New Mexico FTE demonstration, please feel free to give me a call at (701) 777-5158 or e-mail at agrisanti@eerc.und.nodak.edu.

Sincerely,

Ames Grisanti by JC

Ames A. Grisanti
Project Manager

AAG/mro

Enclosure

c/enc: Thomas Hayes, GRI
Susan Joines, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters

December 1, 1996 - December 31, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

January 3, 1997

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997. Site modifications were completed in the second week of December 1996. Construction of the FTE process plant has also been completed.

Task 3 - Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with GRI and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Phase II freezing operations began in early December.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

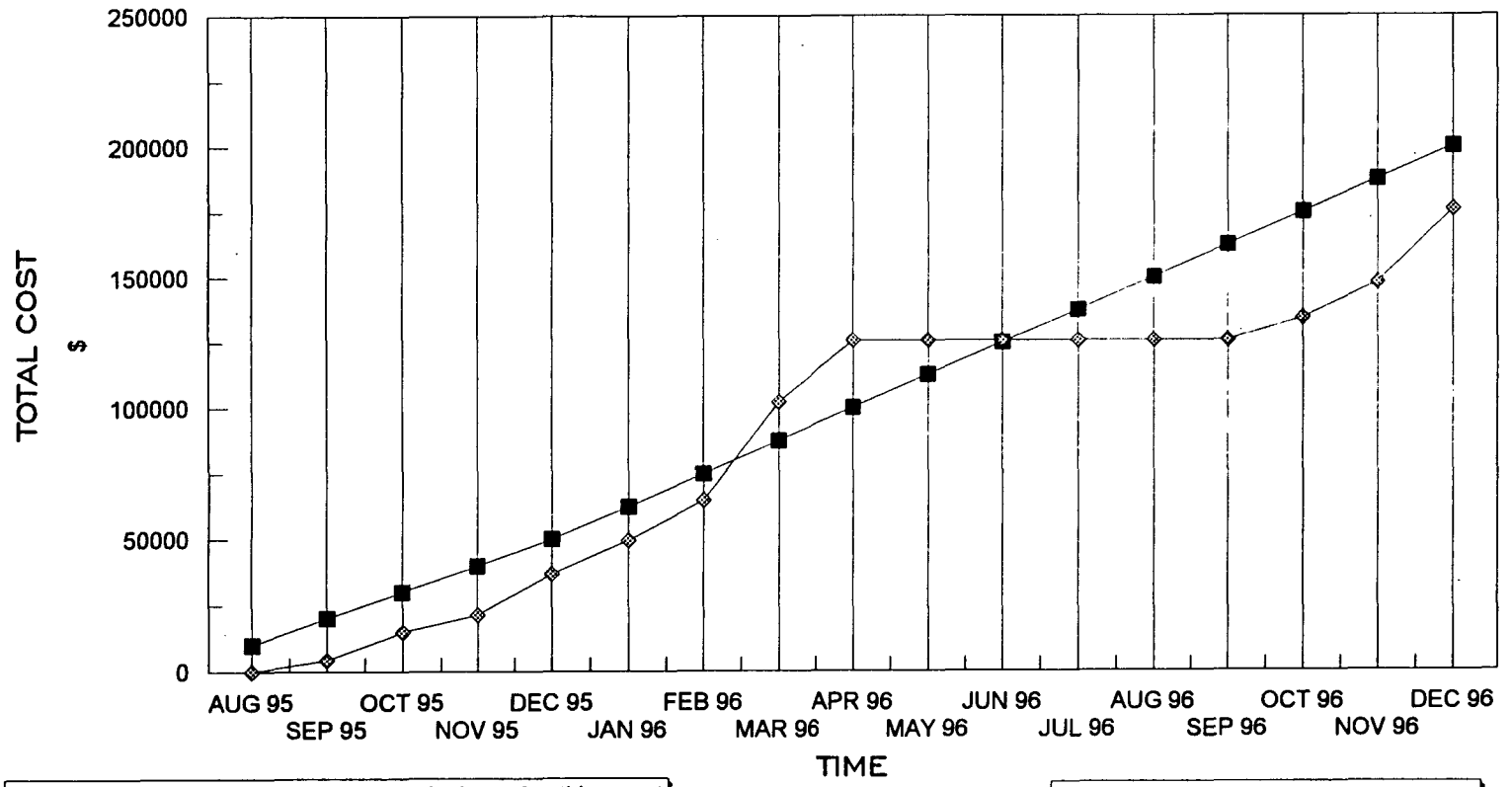
- Activity on this task was initiated in January 1996. At this time, preliminary data suggest that there may be possible uses of the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from the winter of 1995-1996's on-site total dissolved solids determinations has been completed. Additional analytical data will be generated during the winter of 1996-1997 and examined to provide further information regarding potential uses of the brine and/or solids produced.

Other Notes

- Funding has been secured from two sponsors regarding the addition of a uniquely designed storage pond on the site. Discussions with New Mexico's OCD have been initiated regarding the permitting of that pond. It is anticipated, at this time, that the storage pond will not be built on the same site as that of the FTE demonstration. Therefore, modifications to the existing design were undertaken, primarily the addition and plumbing of storage tanks, which will provide increased storage capacity for feed water and intermediate brines.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

December 6, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period November 1, 1996, to November 30, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes; if not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/csd

Enclosure

c/enc: Thomas Hayes, GRI
Wu Lan, DOE FETC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Ames Grisanti, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

November 1, 1996 - November 30, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Federal Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

December 6, 1996

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

November 4, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period October 1, 1996, to October 31, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and a disk copy of the report prepared in WordPerfect® Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/jmm

Enclosure

c/enc: Thomas Hayes, GRI
Wu K. Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC Accounting

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters

October 1, 1996 – October 31, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

November 4, 1996

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996. The primarily minor modifications were designed to ready the site for operation in the winter of 1996-1997. Activity on these modifications was to be initiated in October 1996, but instead will be initiated and completed in November 1996.

Task 3 - Operation of the Freeze-Thaw/Evaporation (FTE) Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with Gas Research Institute (GRI) and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November 1995. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids values for the process streams: feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task was concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-1997. It is anticipated, at this time, that Phase II operations will begin in November 1996.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January 1996. At this time, preliminary data suggest that there may be possible uses for the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from the winter of 1995-1996 on-site total dissolved solids determinations has been completed. Additional analytical data will be generated during the winter of 1996-1997 and examined to provide further information regarding potential uses of the brine and/or solids produced.

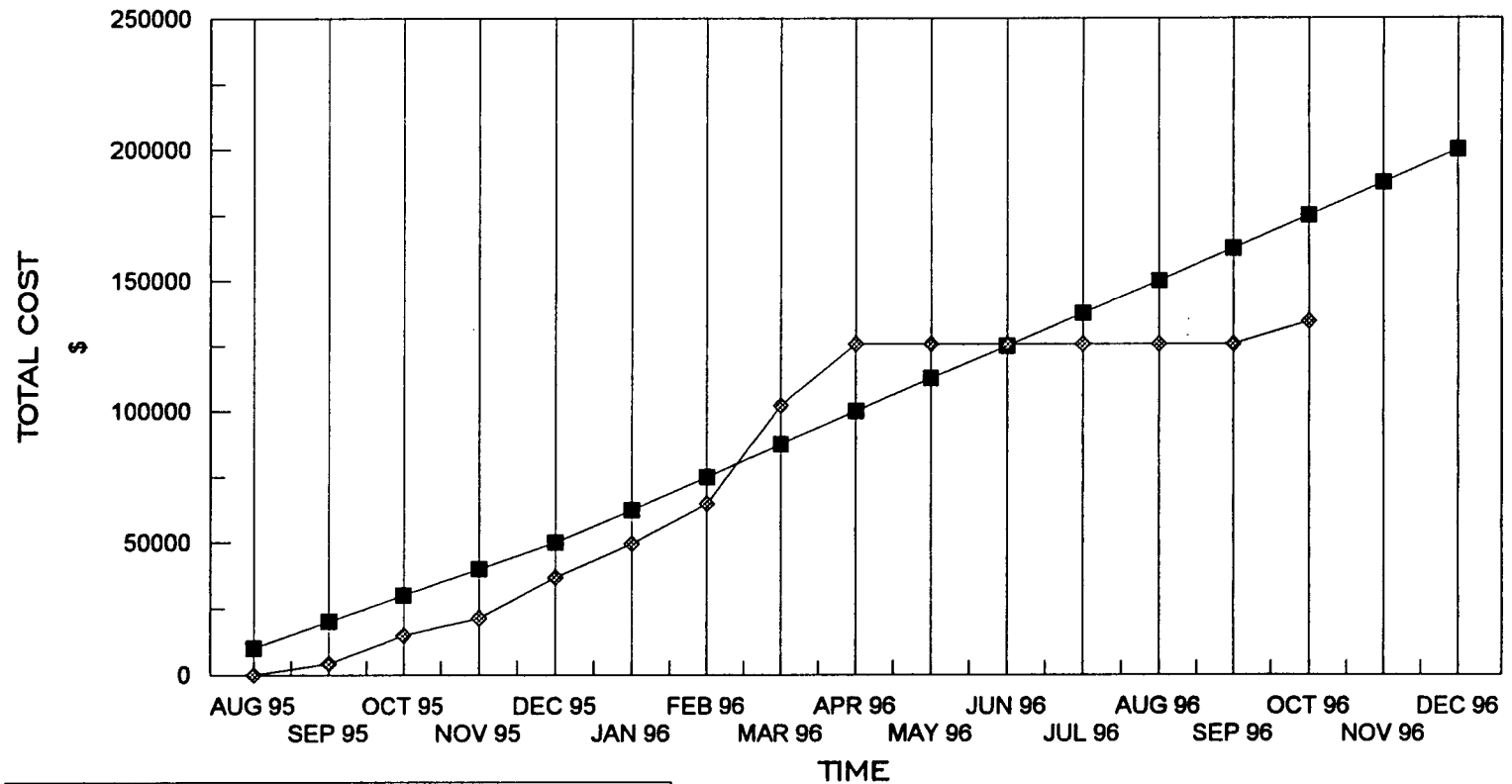
Other Notes

- Funding has been secured from one of two sponsors regarding the addition of a uniquely designed storage pond on the site. A contract is pending with the other sponsor. Discussions with New Mexico's OCD have been initiated regarding the permitting of that pond. If construction of the pond prior to the winter of 1996–1997 FTE operations is precluded by inclement weather or other factors, modifications to the existing design will be undertaken, primarily the addition and plumbing of storage tanks, which will provide increased storage capacity for feed water and intermediate brines.

- Proposals for continuation funding for this program were submitted to GRI (through ReTec) and the U.S. Department of Energy (DOE) in July 1996. Continuous funding has been awarded by DOE.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

October 4, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period September 1, 1996, to September 30, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and a disk copy of the report prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/mro

Enclosure

c/enc: Thomas Hayes, GRI
Wu K. Lan, DOE-METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC Accounting

Monthly Report

Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters

September 1, 1996 – September 30, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

October 4, 1996

SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division (OCD).

Task 2 - Construction and Installation of the Demonstration Facility

- Modifications to the existing site layout were discussed with Amoco in September 1996. The primarily minor modifications were designed to ready the site for operation in the winter of 1996-1997. Activity on these modifications will be initiated in October 1996.

Task 3 - Operation of the Freeze-Thaw Evaporation (FTE) Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with Gas Research Institute (GRI) and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November 1995. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids values for the process streams: feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task was concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-1997.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January 1996. At this time, preliminary data suggest that there may be possible uses for the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from the winter of 1995-1996 on-site total dissolved solids determinations has been completed. Additional analytical data will be generated during the winter of 1996-1997 and examined to provide further information regarding potential uses of the brine and/or solids produced.

Other Notes

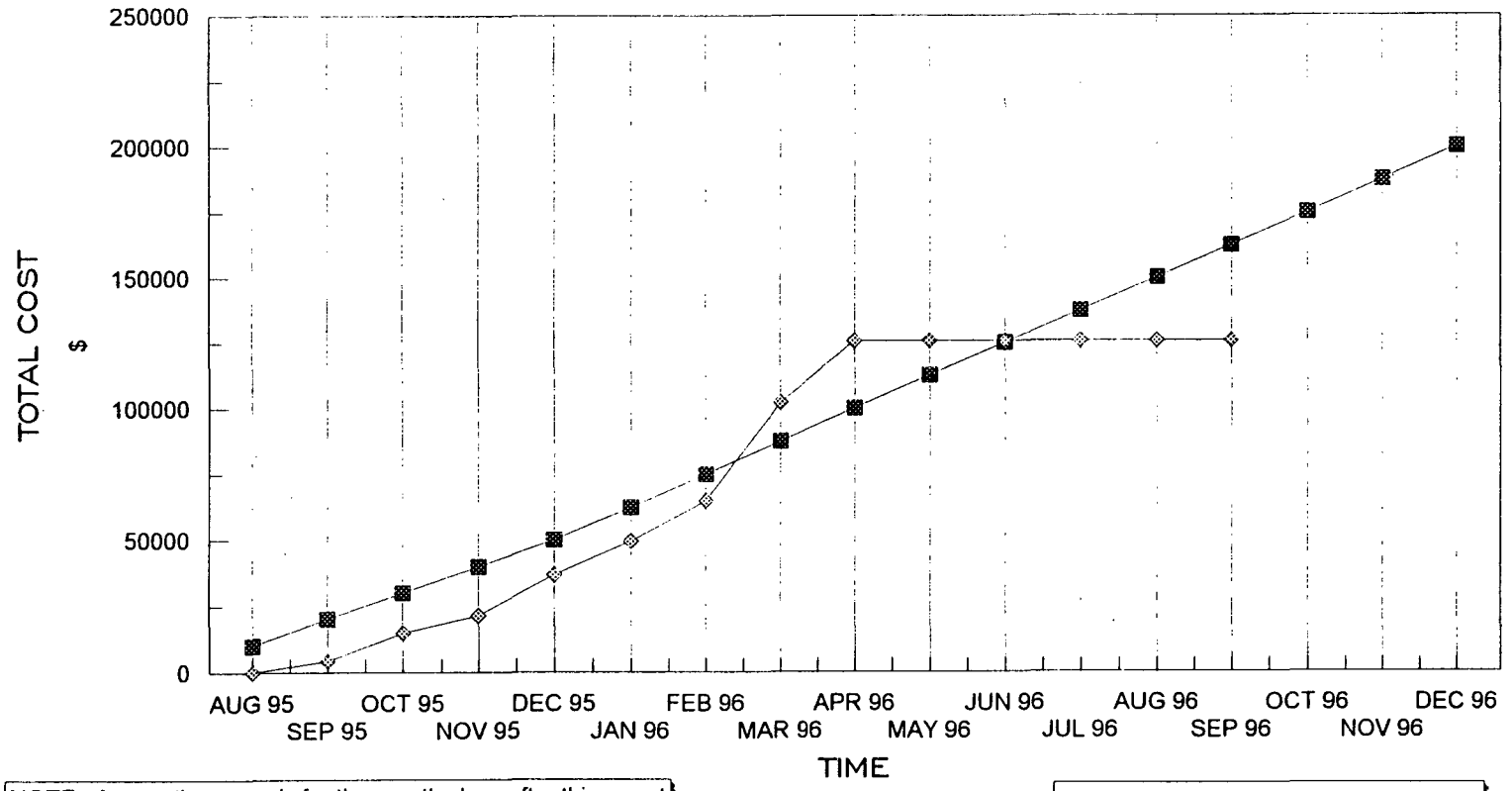
- Funding has been secured from one of two sponsors regarding the addition of a uniquely designed storage pond on the site. A contract is pending with the other sponsor. Discussions with New Mexico's OCD have been initiated regarding the permitting of that pond. It is anticipated that construction of the new pond will be initiated in October 1996. If construction of the pond prior to the winter of 1996–1997 FTE operations is precluded by inclement weather or other factors, modifications to the existing design will be undertaken, primarily the addition and plumbing of storage tanks, which will provide increased storage capacity for feed water and intermediate brines.

- Proposals for continuation funding for this program were submitted to GRI (through ReTec) and the U.S. Department of Energy in July 1996.

- A paper was presented at the Third International Petroleum Environmental Conference – Environmental Issues and Solutions in Exploration, Production, and Refining, in Albuquerque, New Mexico, on September 24, 1996.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

September 5, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period August 1, 1996, to August 31, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/ Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/csd

Enclosure

c/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

August 1, 1996 - August 31, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

September 5, 1996

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2 - Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and the cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been completed. Some slight modifications to the construction have been completed. Activities on-site will be initiated in September 1996, primarily minor modifications to ready the site for operation in the winter of 1996-1997.

Task 3 - Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with GRI and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November 1995. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids (TDS) values for the process streams, feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task was concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-1997.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January 1996. At this time, preliminary data suggest that there may be possible uses of the brine in the Farmington, NM, area. Analytical characterization of residual solids obtained from on-site TDS determinations have been completed. Detailed review of the data generated is under way.

Other Notes

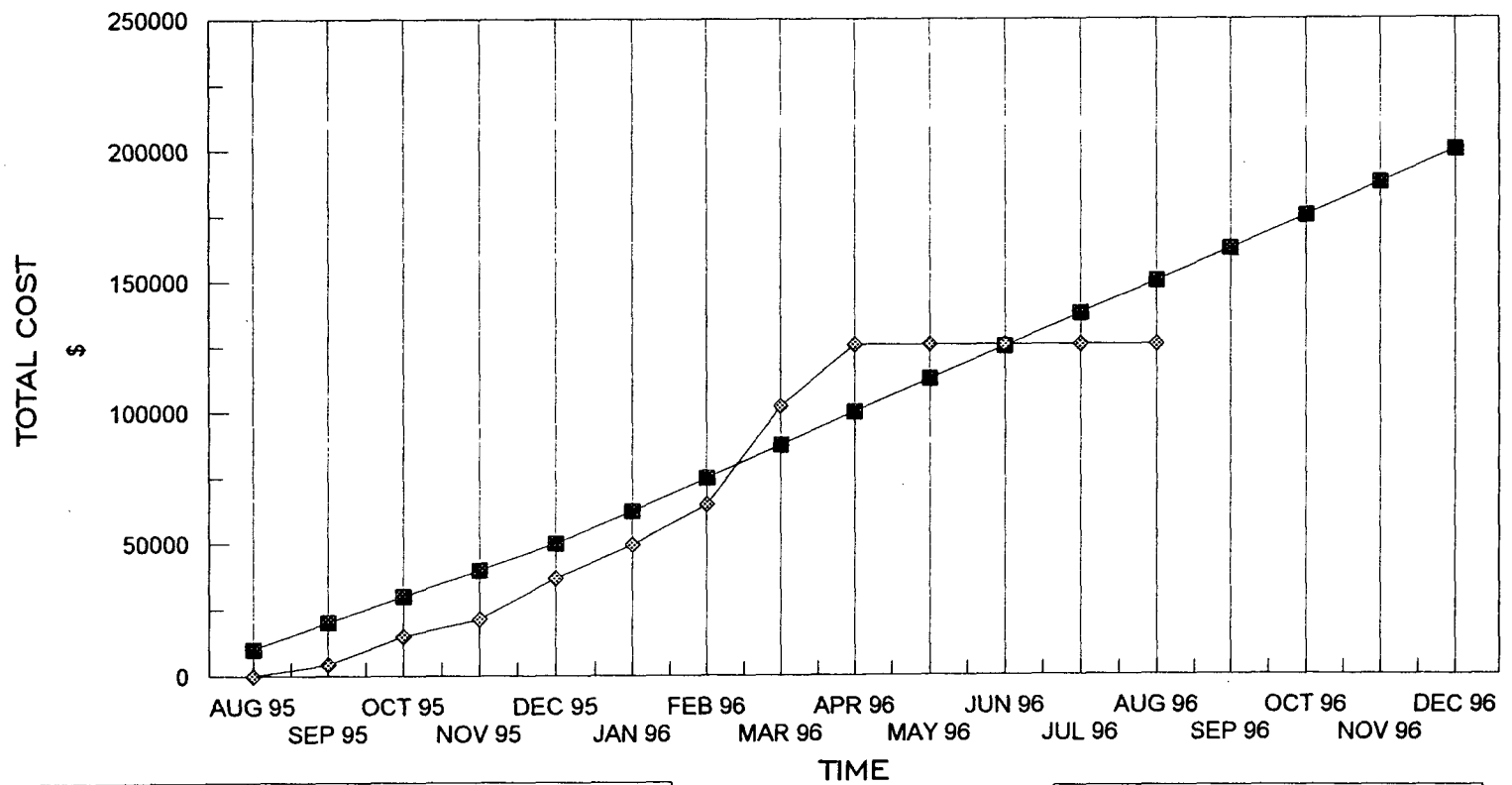
- Following discussions with GRI and Amoco Production Company, it was decided to wrap up this year's freezing demonstration in mid- to late March and resume operations in the fall of 1996, continuing through the winter of 1996-1997. The evaporation process operation and evaluation will be conducted in the summer of 1997. Work will be initiated in September 1996, primarily activities focused on preparing the site for the next winter (1996-1997) of freezing operation.

- Funding has been secured from one of two sponsors regarding the addition of a uniquely designed storage pond on the site. A contract is pending with the other sponsor. It is anticipated that construction of the new pond will be initiated in October 1996.

- Proposals for continuation funding for this program were submitted to GRI (through ReTec) and DOE in July 1996.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

SUBJECT Demonstration Pond

Roger 9/26/96

Here is the proposal that I talked to you about in conjunction with the Freeze-Thaw test.

If we need to formalize it, let me know as soon as possible.

Thanks,

Buddy

Amoco

326-9219

P.S. We will not pursue if landowner does not approve (Virginia Ulden)

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

AUG - 5 1996

August 1, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period July 1, 1996, to July 31, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/jmm

Enclosure

c/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

July 1, 1996 - July 31, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

August 1, 1996

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2 - Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and the cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been completed. Some slight modifications to the construction have been completed.

Task 3 - Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with Gas Research Institute (GRI) and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November 1995. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids (TDS) values for the process streams, feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task was concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-1997.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January. At this time preliminary data suggest that there may be possible uses for the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from on-site total dissolved solids determinations have been completed. Detailed review of the data generated is under way.

Other Notes

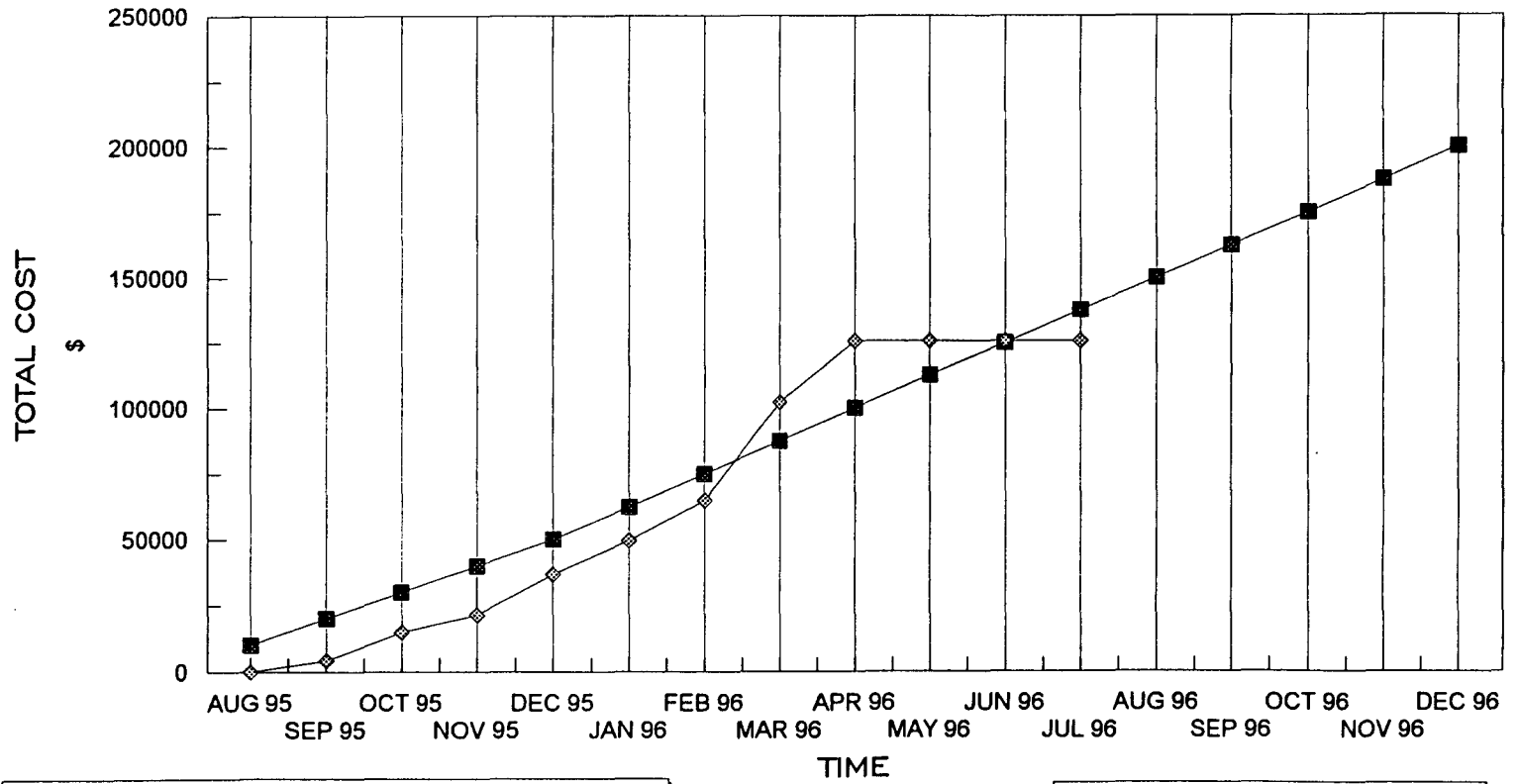
- Following discussions with GRI and Amoco Production Company, it was decided to wrap up this year's freezing demonstration in mid- to late March and resume operations in the fall of 1996, continuing through the winter of 1996-1997. The evaporation process operation and evaluation will be conducted in the summer of 1997. Some minimal work will be conducted over the summer of 1996, primarily activities focused on preparing the site for the next winter (1996-1997) of freezing operation.

- Discussions with potential sponsors regarding the addition of a uniquely designed storage pond on the site have continued. A full proposal has been submitted to two potential sponsors. Funding will likely be in place in August, 1996.

- Proposals for continuation funding for this program were submitted to GRI (through ReTec) and DOE in July 1996.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



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Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

June 5, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period May 1, 1996, to May 31, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/jmm

Enclosure

c/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

May 1, 1996 - May 31, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

June 5, 1996

Task 1 - Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2 - Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and the cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been completed. Some slight modifications to the construction have been completed.

Task 3 - Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with Gas Research Institute (GRI) and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4 - Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November 1995. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids (TDS) values for the process streams, feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task was concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-1997.

Task 5 - Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January. At this time preliminary data suggest that there may be possible uses for the brine in the Farmington, New Mexico, area. Analytical characterization of residual solids obtained from on-site total dissolved solids determinations have been completed. Detailed review of the data generated is under way.

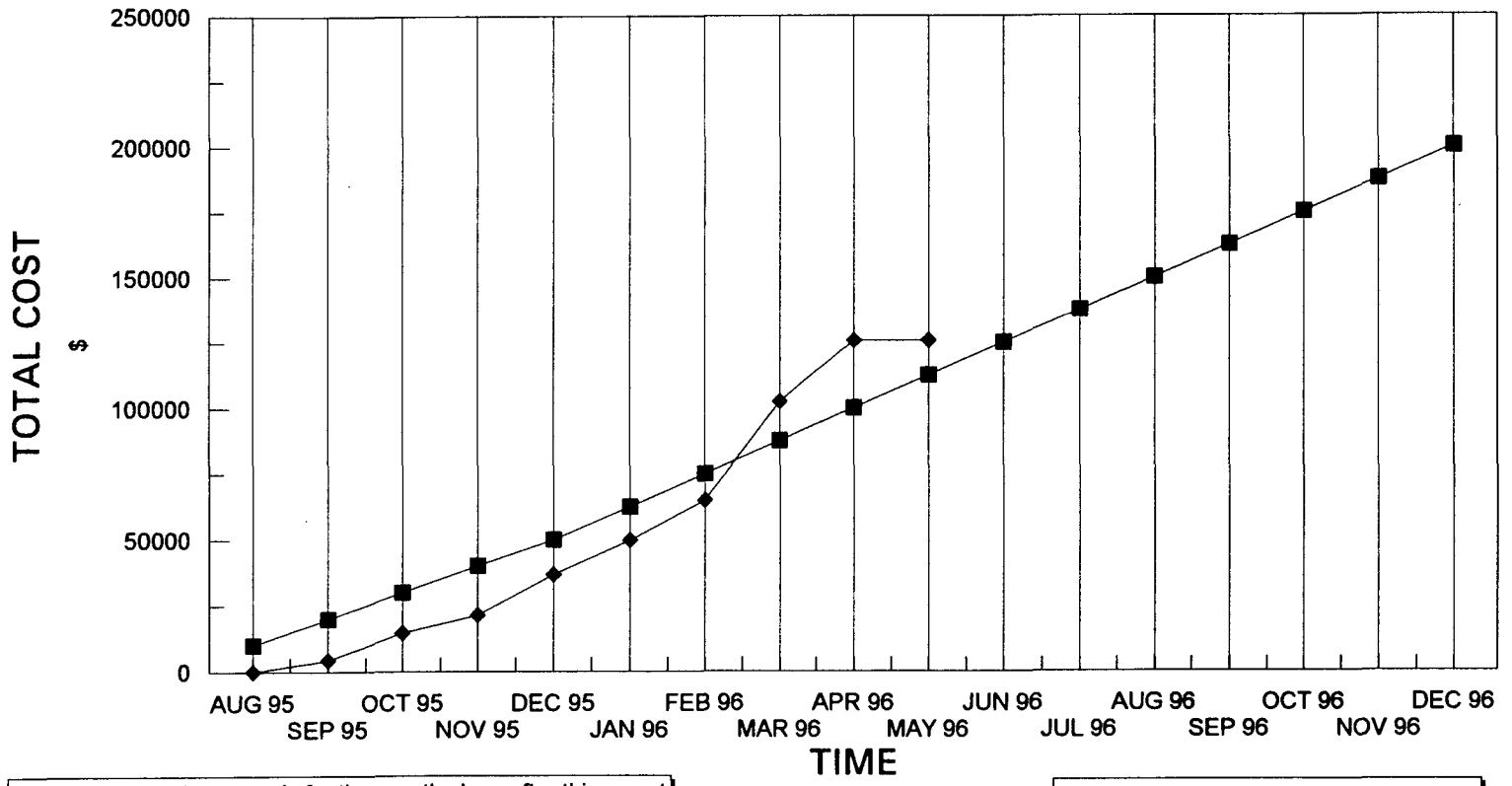
Other Notes

- Following discussions with GRI and Amoco Production Company, it was decided to wrap up this year's freezing demonstration in mid- to late March and resume operations in the fall of 1996, continuing through the winter of 1996-1997. The evaporation process operation and evaluation will be conducted in the summer of 1997. Some minimal work will be conducted over the summer of 1996, primarily activities focused on preparing the site for the next winter (1996-1997) of freezing operation.

- Discussions with potential sponsors regarding the addition of a uniquely designed storage pond on the site have continued. A full proposal has been submitted to one of the potential sponsors.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



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Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street – PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

May 2, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period April 1, 1996, to April 30, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw/Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/jmm

Enclosure

c/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze–Thaw/Evaporation Process to Treat Oil and Gas Produced Waters"

April 1, 1996 – April 30, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

May 2, 1996

Task 1
Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2
Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been completed. Some slight modifications to the construction have been completed.

Task 3
Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project and subsequent discussions with Gas Research Institute (GRI) and Amoco Production Company, it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4
Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November 1995. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids values for the process streams, feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task was concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-1997.

Task 5
Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January. At this time, preliminary data suggest that there may be possible uses of the brine in the Farmington, New Mexico, area. Some additional characterization of the brine and solids resulting from the process will be conducted over the summer of 1996. The data generated from these activities will facilitate the conduct of this task.

Other Notes

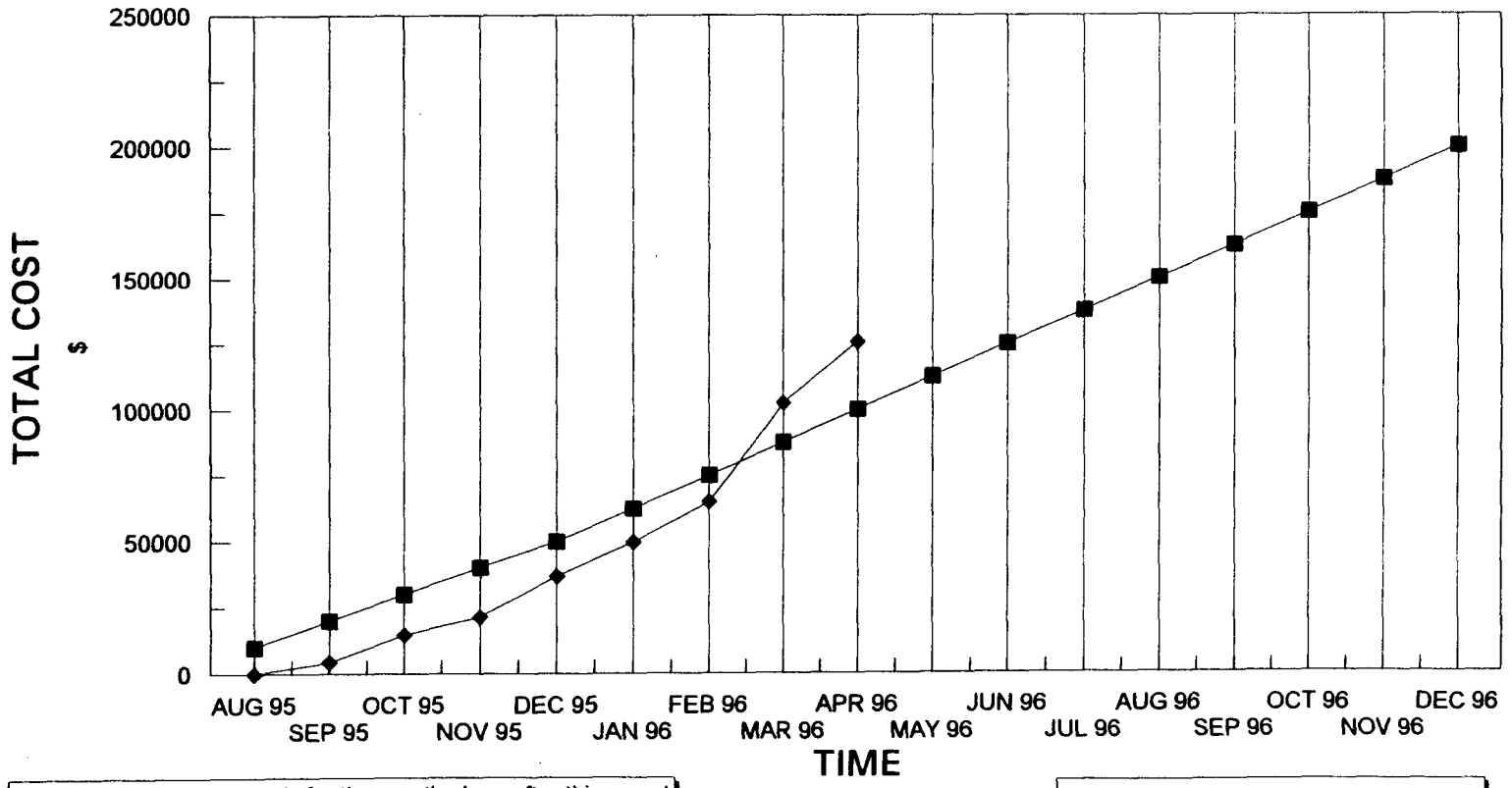
- Following discussions with GRI and Amoco Production Company, it was decided to wrap up this year's freezing demonstration in mid- to late March and resume operations in the fall of 1996, continuing through the winter of 1996–1997. The evaporation process operation and evaluation will be conducted in the summer of 1997. Some minimal work will be conducted over the summer of 1996, primarily activities focused on preparing the site for the next winter (1996–1997) of freezing operation.

- Field design, operations, and evaluation data were provided to Alonzo Lawrence for presentation at GRI's Supply Projects Advisory Group meeting in April 1996.

- Discussions with potential sponsors regarding the addition of another, uniquely designed storage pond on the site have been promising.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

March 11, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period February 1, 1996, to February 29, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes; if not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/jmm

Enclosures

c:/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

"SMALL-SCALE DEMONSTRATION OF THE FREEZE-THAW EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS"

February 1, 1996 - February 29, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

March 11, 1996

Task 1
Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2
Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and the cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been completed. Some slight modifications to the construction have been completed.

Task 3
Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project, and subsequent discussions with Gas Research Institute (GRI) and Amoco Production Company it is anticipated that this activity will be conducted in the summer of 1997, rather than the summer of 1996, as modified and reported previously. Please note that as originally proposed, this task was to be conducted in the summer of 1995.

Task 4
Operation of the FTE Process - Freezing

- Initial operation of the facility was begun in late November. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. Detailed sample characterization of the feed, ice, and brine was conducted in February and resulted in the following total dissolved solids (TDS) values for the process streams: feed (11,600 mg/L), brine (56,900 mg/L), and ice melt (940 mg/L). Activity on this task will be concluded in mid-March 1996 and will resume in the fall of 1996 and operate through the winter of 1996-97.

Task 5
Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January. At this time, preliminary data suggest that there may be possible uses of the brine in the Farmington, New Mexico, area.

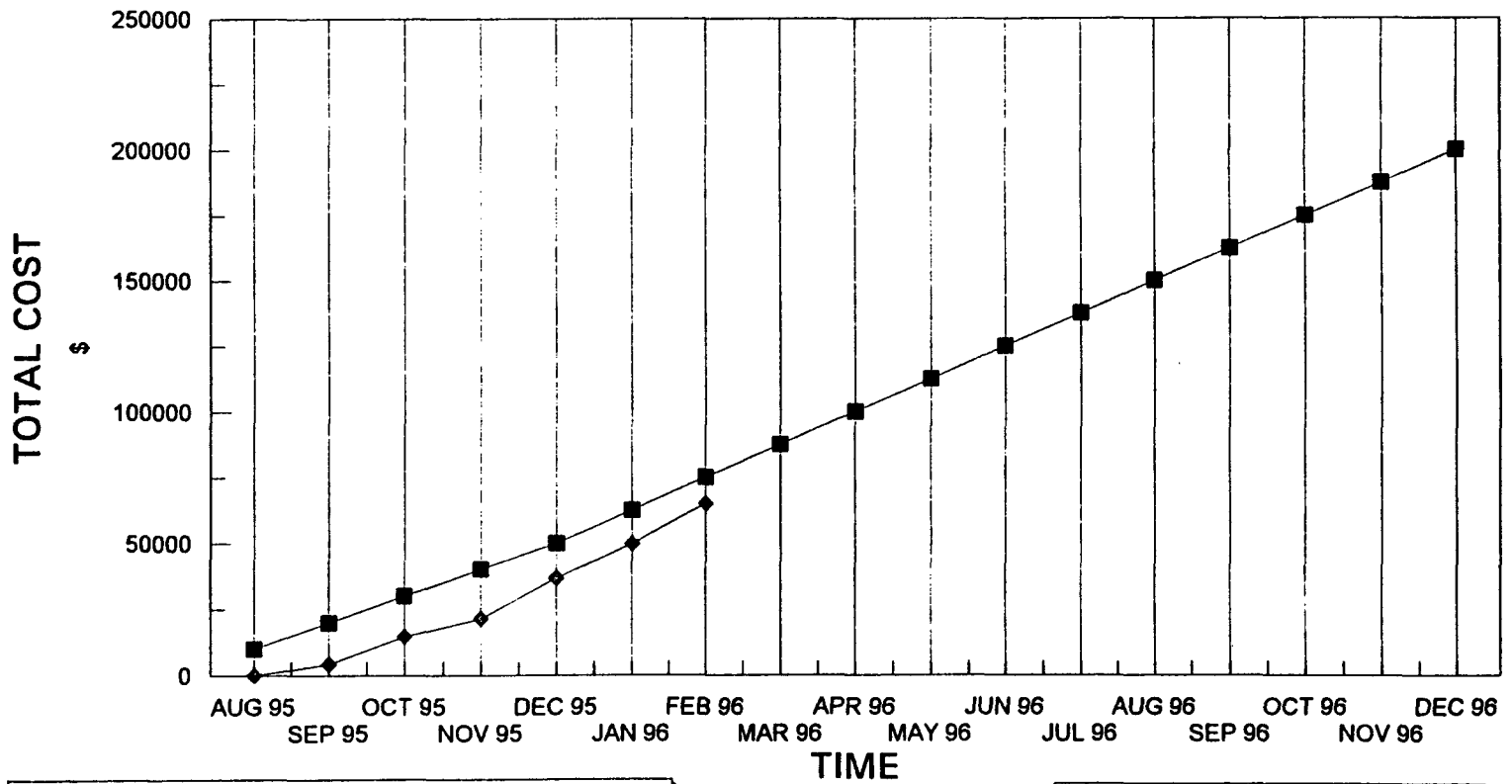
Other Notes

- An abstract (attached) was submitted for the 1996 International Petroleum Environmental Conference to be held in Albuquerque, New Mexico, in September 1996.

- Following discussions with GRI and Amoco Production Company, it was decided to wrap up this year's freezing demonstration in mid- to late March and resume operations in the fall of 1996, continuing through the winter of 1996–97. The evaporation process operation and evaluation will be conducted in the summer of 1997.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

FIELD DEMONSTRATION OF THE FREEZE-THAW/EVAPORATION PROCESS FOR THE TREATMENT OF PRODUCED WATERS IN THE SAN JUAN BASIN OF NEW MEXICO

John E. Boysen
B.C. Technologies, Ltd.
507 Ivinson St.
Laramie, WY 82070

John A. Harju
Energy and Environmental Research Center
University of North Dakota
P.O. Box 9018
Grand Forks, ND 58202-9018

Buddy Shaw
Amoco Production Company
San Juan Operations Center
200 Amoco Court
Farmington, NM 87401

Thomas D. Hayes
Gas Research Institute
8600 West Bryn Mawr Avenue
Chicago, IL 60631-3562

Abstract

Historically, treatment utilizing freeze-crystallization has been an economically proven method for purifying most waters. Water purification using naturally occurring freezing is an economic and attractive process in oil and gas producing regions where climatic conditions seasonally promote freezing. Research sponsored by Amoco Production Company, the US Department of Energy, and Gas Research Institute to develop a commercially-economic natural freeze-thaw/evaporation (FTE) purification process for produced waters has been conducted since 1992. Preliminary FTE field demonstration results from northwestern New Mexico during the winter of 1995-96 indicate significant and simultaneous removal of salts, metals, and organics from produced water. Despite the unusually warm winter, process yields demonstrate disposal volume reductions on the order of 80% and confirm the potential for economical production of water suitable for various beneficial uses. The total dissolved solids concentrations of the FTE demonstration streams were 11,600 mg/L (feed), 56,900 mg/L (brine), and 940 mg/L (ice melt).

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

February 6, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period January 1-31, 1996, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/dak

Enclosures

c/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze–Thaw Evaporation Process to Treat Oil and Gas Produced Waters"

January 1, 1996 - January 31, 1996

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

February 6, 1996

Task 1
Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2
Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and the cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been completed. Some slight modifications to the construction have been completed.

Task 3
Operation of the FTE Process – Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project, it is anticipated that this activity will be conducted in the summer of 1996, rather than the summer of 1995, as originally proposed.

Task 4
Operation of the FTE Process – Freezing

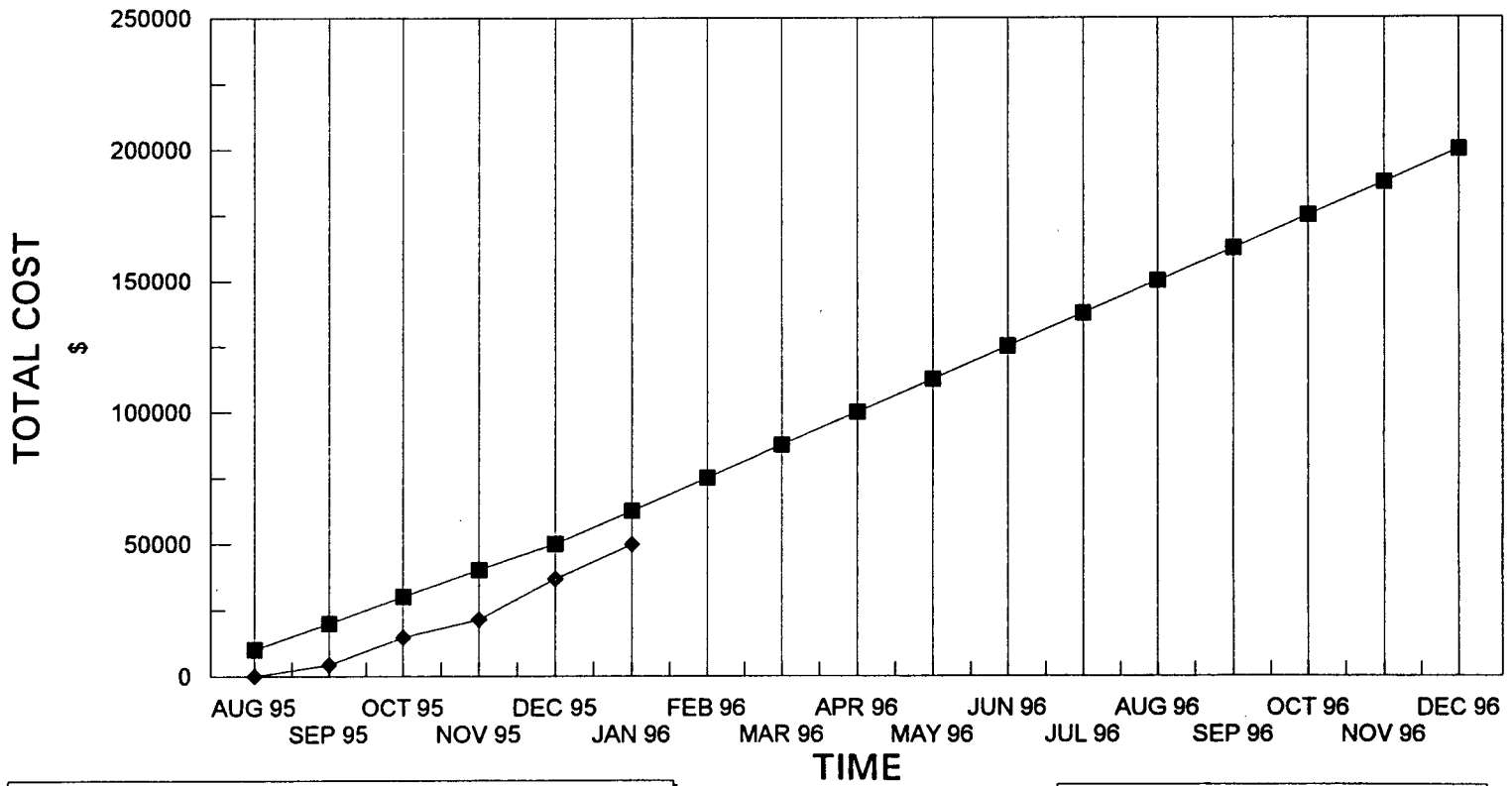
- Initial operation of the facility was begun in late November and resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appeared extremely promising. January's operation resulted in significant ice production. On-site gravimetric total dissolved solids analysis indicates that the process is working extremely well. Total feed to the demonstration is in the neighborhood of 10,000 barrels, with approximately 8000 barrels of ice produced. Detailed sample characterization of the feed, ice, and brine will be concluded in early February.

Task 5
Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- Activity on this task was initiated in January. At this time preliminary data suggest that there may be possible uses of the brine in the Farmington, New Mexico, area.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



NOTE: Accounting records for the month close after this report is due. Therefore, this is an estimate.

Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

January 5, 1996

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period December 1, 1995, to December 31, 1995, for the project entitled "Small-Scale Demonstration of the Freeze-Thaw Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes. If not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/jmm

Enclosure

c/enc: Wu K. Lan, DOE-METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
Debby Johnson, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze–Thaw Evaporation Process to Treat Oil and Gas Produced Waters"

December 1, 1995 - December 31, 1995

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

January 5, 1995

Task 1
Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2
Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has been completed. Some slight modifications to the previous construction have also been completed.

Task 3
Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project, it is anticipated that this activity will be conducted in the summer of 1996, rather than the summer of 1995, as originally proposed.

Task 4
Operation of the FTE Process - Freezing

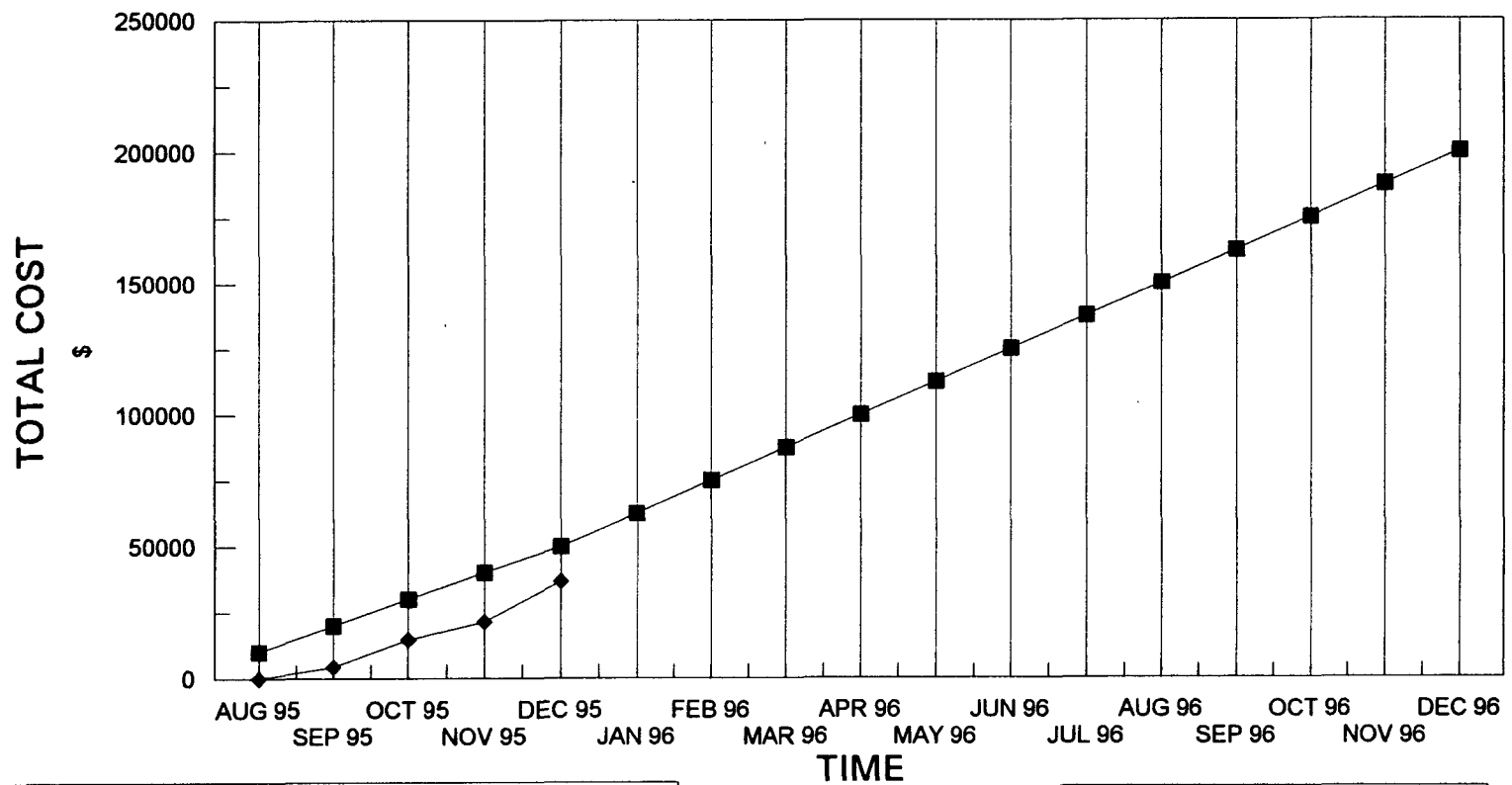
- Initial operation of the facility was begun in late November. Initial operation resulted in the need for some slight modifications to the facility as constructed. Full-scale operation of the process began in mid-December, and initial results appear extremely promising.

Task 5
Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- No activity on this task has been conducted at this time.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



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Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

December 5, 1995

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period November 1 to November 30, 1995, for the project entitled "Small-Scale Demonstration of the Freeze–Thaw Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost-vs.-time graph for the project and a disk copy of the report, prepared in WordPerfect Version 6.1.

I hope that this is sufficient for your purposes; if not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/csd

Enclosures

c/enc: Wu Lan, DOE METC
John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
John Foster, EERC
EERC Accounting

Energy & Environmental Research Center

Monthly Report

"Small-Scale Demonstration of the Freeze–Thaw Evaporation Process to Treat Oil and Gas Produced Waters"

November 1, 1995 – November 30, 1995

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

December 5, 1995

Task 1 – Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was previously requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2 – Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and cleaning of the existing (freezing) pit for the demonstration have been completed. Construction of the facility has also been initiated and is nearing completion. Some slight modifications to the construction are currently under way.

Task 3 – Operation of the FTE Process – Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project, it is anticipated that this activity will be conducted in the summer of 1996, rather than the summer of 1995, as originally proposed.

Task 4 – Operation of the FTE Process – Freezing

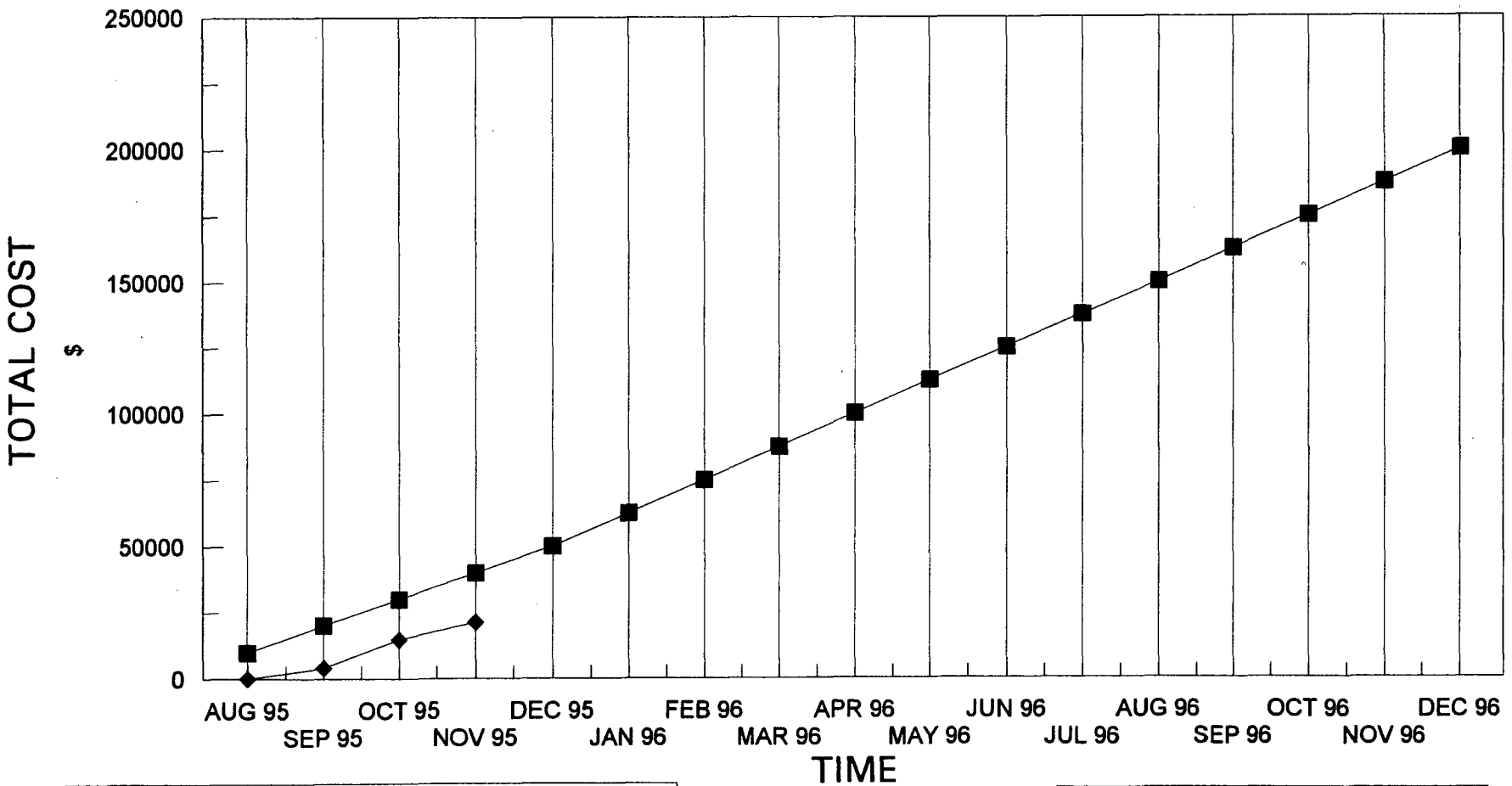
- Initial operation of the facility was begun in late November, resulting in the need for some slight modifications to the facility as constructed. Full-scale operation of the process is anticipated to begin in early to mid-December.

Task 5 – Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- No activity on this task has been conducted at this time.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



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Energy & Environmental Research Center
UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World-Wide Web Server Address: http://www.eerc.und.nodak.edu

November 3, 1995

Mr. Alonzo Lawrence
Principal
Remediation Technologies, Inc.
3340 William Pitt Way
Pittsburgh, PA 15238

Dear Lonny:

Please find enclosed a copy of the monthly report for the period October 1, 1995, to October 31, 1995, for the project entitled "Small-Scale Demonstration of the Freeze–Thaw Evaporation Process to Treat Oil and Gas Produced Waters." I have also included a cost vs. time graph for the project and a disk copy of the report, prepared in Wordperfect Version 6.1.

I hope that this is sufficient for your purposes, if not, please feel free to give me a call at (701) 777-5208.

Sincerely,

John A. Harju
Senior Research Manager

JAH/rss

Enclosure

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John Boysen, B.C. Technologies
Buddy Shaw, Amoco
Rich Symuleski, Amoco
Chris Eustice, NM OCD
Ed Steadman, EERC
Dan Stepan, EERC
H. John Foster, EERC

Monthly Report

"Small-Scale Demonstration of the Freeze-Thaw Evaporation Process to Treat Oil and Gas Produced Waters"

October 1, 1995–October 31, 1995

Submitted to:

Remediation Technologies, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

and

U.S. Department of Energy
Morgantown Energy Technology Center
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Submitted by:

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, North Dakota 58202-9018

GRI Agreement 5091-253-2215

and

U.S. Department of Energy
Cooperative Agreement Contract No. DE-FC21-93MC30098

November 3, 1995

Task 1
Acquisition of Regulatory Approval

- Regulatory approval for the demonstration was requested from and granted by the state of New Mexico's Oil Conservation Division.

Task 2
Construction and Installation of the Demonstration Facility

- Acquisition of the necessary supplies (piping, pumps, tanks, and instrumentation) and cleaning of the existing (freezing) pit for the demonstration has been initiated. Construction of the facility has also been initiated and will likely be completed in mid-November.

Task 3
Operation of the FTE Process - Evaporation

- No activity has been conducted on this task at this time. Given the late starting date of the project, it is anticipated that this activity will be conducted in the summer of 1996, rather than the summer of 1995, as originally proposed.

Task 4
Operation of the FTE Process - Freezing

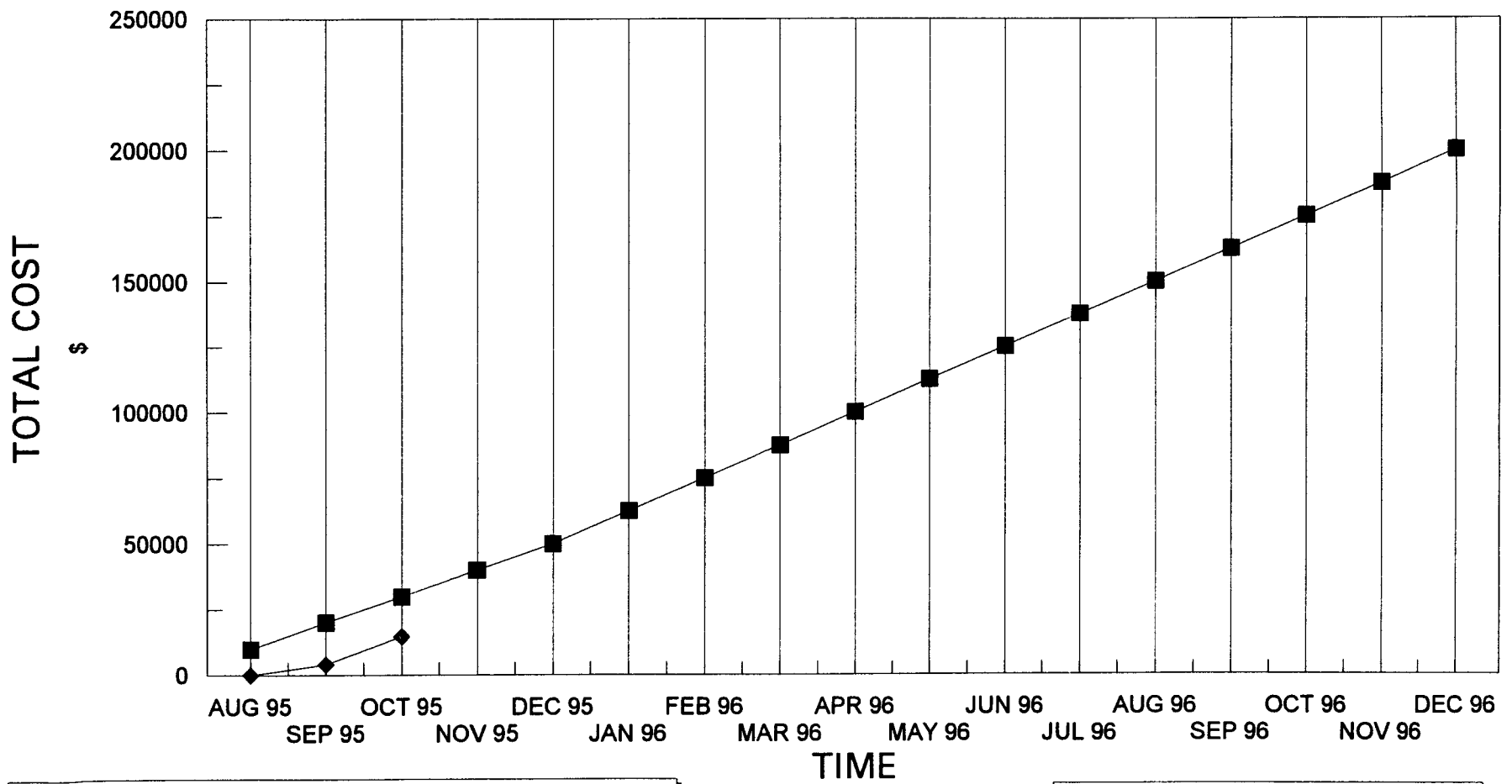
- No activity has been conducted on this task at this time. Operation of the process is anticipated to begin in late November.

Task 5
Survey of Potential Markets and Beneficial Uses for Treated Water and Brine

- No activity on this task has been conducted at this time.

COST VS. TIME - RETEC SHARE

Small Scale Demonstration of the Freeze-Thaw Process to Treat Oil and Gas Produced Waters



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NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
2040 S. Pacheco
Santa Fe, New Mexico 87505

September 19, 1995

CERTIFIED MAIL
RETURN RECEIPT NO.P-176-012-190

Mr. Buddy Shaw
Amoco Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: Field Test for the Beneficial Use of Produced Water
San Juan County, New Mexico

Dear Mr. Shaw:

The Oil Conservation Division (OCD) has received Amoco Production Company's (Amoco) request dated August 25, 1995 to field test recycling technologies at Amoco's Cahn and Schneider centralized evaporation facilities.

Your request is hereby approved subject to the following conditions:

1. This approval is for a period of six (6) months beginning October 1, 1995 and expiring March 31, 1996.

2. No associated wastes will be allowed to leave the Cahn and/or Schneider centralized waste management facilities without prior approval of the OCD.

3. The OCD will be provided with any documented test results and/or reports.

4. Any associated spills will be subject to the OCD Rule 116 notification requirements.

Please be advised OCD approval does not relieve Amoco of liability should their operation result in pollution of ground water, surface water or the environment. In addition OCD approval does not relieve Amoco of responsibility for compliance with other federal, state and/or local regulations.

Southern Rockies Business Unit

San Juan Operations Center

AUGUST 28,1995

NEW MEXICO OIL CONSERVATION DIVISION
2040 S. PACHECO
SANTA FE,NM 87505

ATTENTION: ROGER ANDERSON

FIELD TEST--BENEFICIAL USE OF PRODUCED WATER

AMOCO PRODUCTION COMPANY REQUESTS APPROVAL TO FIELD TEST THE FOLLOWING TECHNOLOGIES AT OUR CAHN AND SCHNEIDER EVAPORATION POND FACILITIES NEAR CEDAR HILL,NM.

1.ELECTROLYSIS
2.FREEZE-THAW
3.REVERSE OSMOSIS

ALL DISCHARGES WILL GO TO OUR PONDS OR TANKAGE. WE ESTIMATE THE TEST TO LAST FROM OCTOBER,1995 THROUGH MARCH, 1996.
AMOCO ALSO REQUESTS TO TEST ENHANCED OIL RECOVERY WITH THE USE OF MICROBES AT THE CEDAR HILL BAD OIL FACILITIY WHICH IS CO-LOCATED AT THE SCHNEIDER EVAPORATION POND SITE.
ATTACHED ARE DIAGRAMS FURTHER EXPLAINING OUR REQUESTS. PLEASE CALL IF YOU HAVE ANY QUESTIONS. THANK YOU FOR YOUR CONSIDERATION.

Buddy Shaw

BUDDY SHAW
ENVIRONMENTAL COORDINATOR
(505) 326-9219

SMALL-SCALE PROPOSAL FOR DEMONSTRATION OF THE FREEZE-THAW EVAPORATION PROCESS TO TREAT OIL AND GAS PRODUCED WATERS

This proposal discusses a small-scale demonstration of the freeze-thaw evaporation (FTE) process to treat oil and gas produced waters at Amoco's Snyder Evaporation Facility in northern New Mexico. The proposed project would be jointly conducted by personnel from Amoco, the University of North Dakota Energy & Environmental Research Center (EERC), and B.C. Technologies. The project duration would be 17 months, with a minimum of 12 months of demonstration.

BACKGROUND

Development of the FTE process began in 1992 by personnel of Resource Technologies Corporation (RTC project personnel are now B.C. Technologies) and the EERC, with sponsorship by the U.S. Department of Energy (DOE) and Gas Research Institute. The FTE process economically couples evaporation and freeze crystallization water purification technologies. During warm months, the FTE process is operated as a conventional evaporation facility. However, during months with subfreezing (<32°F) temperatures, a large ice pile is created by spraying water in a shallow, lined pit. Continuous monitoring of the total dissolved solids (TDS) concentration of the ice pile runoff allows the runoff to be recycled or separated as clean water or heavy brine. The clean (treated) water can be sold or beneficially reused, while the brine can be further evaporated to solids or disposed of by conventional methods such as deep well injection.

A literature survey, numerical process and economic modeling, and laboratory-scale process simulations have been completed. Previous research and the results of laboratory simulations confirm the ability of the process to produce a usable-quality treated water. Twenty-one simulations have verified significant and simultaneous removal of salts, organics, and heavy metals (including naturally occurring radioactive material) from natural gas produced water, oil and gas produced water, and a coal bed methane produced water, under a variety of climatic conditions. Attachment A provides tables summarizing the results of a simulation done during 182 hours of freezing condition using coal bed methane water from the San Juan Basin. The treated water TDS concentration was 286 ppm, and virtually all detectable inorganic, organic, and radionuclide components were significantly reduced compared to the produced-water feed and the water in the evaporation pond when the freezing treatment was initiated. Brine requiring further evaporation or disposal was 13% of the total feed input, and the treated water produced was 39% of the feed input. The simulations were designed to simulate climatic conditions of various regions, but analysis indicates the age of the ice pile (hours of freezing) was the key parameter affecting results. Therefore, we expect a field demonstration to yield even more favorable results, since the Farmington, New Mexico, region typically has 1100 hours with subfreezing temperatures, and the maximum hours of subfreezing temperatures in the simulations was 182 hours.

Economic results indicate that the FTE process could reduce water disposal costs up to 70% compared with conventional evaporation alone. The reduction depends upon the climate and feed water quality. Water disposal costs for an FTE facility in the San Juan Basin that is fed more than 500 barrels per day of 12,000 ppm TDS water range from $0.05 to $0.50/bbl. Treatment costs are dependent upon the facility size, state and federal regulatory requirements for pit construction, facility operation, and water discharge/use.

OBJECTIVES AND SCOPE OF WORK

The general scope of work for the proposed small-scale FTE demonstration is summarized below.

Task 1. Acquisition of the required regulatory approval for the demonstration, with the objective of acquiring the regulatory approval and permits to construct the three required ponds (freezing pad, brine pond, and treated water pond) and conduct the FTE demonstration during the winter of 1995–1996. This task will be conducted primarily by Amoco personnel, with assistance from EERC and B.C. Technologies personnel.

need diagram & plans

Task 2. Construction of the three pits and installation of piping, pumps, and instrumentation required to conduct the FTE demonstration. This task will be conducted by Amoco, with B.C. Technologies and EERC personnel assisting in installation of equipment related to the FTE process.

same as above

Task 3. Operation of the FTE process, with the objectives of collecting sufficient climatic, water quality, and evaporation performance data during the summer of 1995 to validate and/or modify the existing process model so that it may be used to more accurately project commercial-scale FTE requirements and economics. Evaporation operation will be conducted by Amoco, with B.C. Technologies and the EERC being responsible for data collection that is not included as routine operation of the evaporation facility.

Task 4. Operation of the FTE process. The objectives of this task are to 1) conduct the FTE demonstration and confirm the technical and economic feasibility of the process, 2) collect sufficient data during the operation to accurately evaluate process performance and economics, and 3) collect sufficient data to demonstrate environmental acceptability of the process to state and federal regulatory personnel. This task will be conducted primarily by B.C. Technologies and EERC personnel, with assistance by Amoco personnel at a level they select.

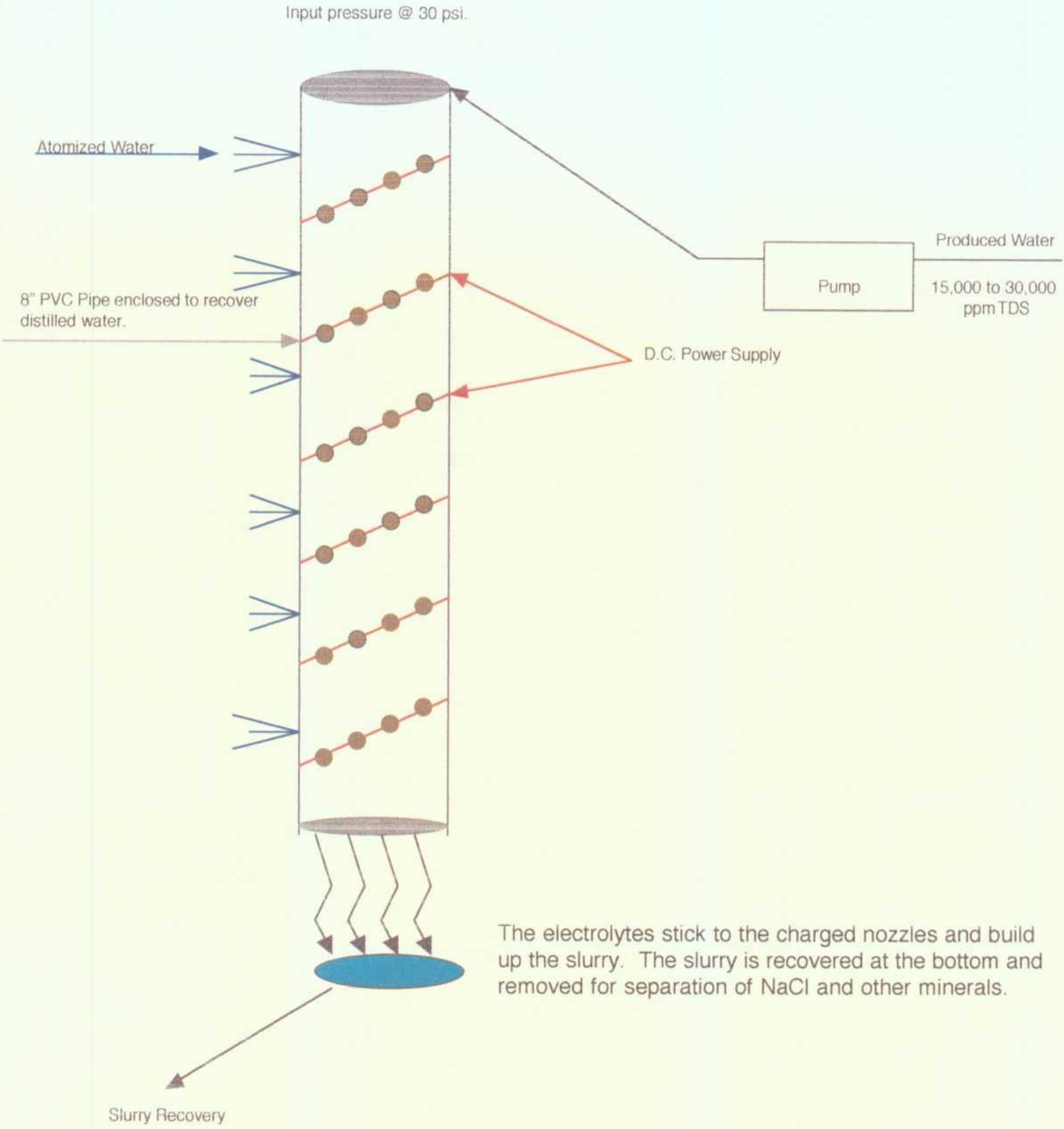
Task 5. Survey of potential markets and beneficial uses for the treated water and brine, together with an overall technical and economic evaluation. The objectives of this task are to 1) investigate potential economic markets for the treated water produced during the FTE demonstration, 2) collect sufficient data to accurately evaluate economic disposal options for the brine and/or solids, and 3) gain required regulatory approval for the optimum disposal option. Research related to Objectives 1 and 2 will be conducted by B.C. Technologies and EERC personnel. Objective 3 work will be conducted by Amoco, with assistance from B.C. Technologies and EERC personnel.

PROJECT MANAGEMENT

The EERC will take the lead in overall project management. The EERC proposes that a technical management team be assembled with representatives of the EERC (for DOE), B.C. Technologies, GRI, and Amoco. The technical management team members, envisioned at this time would be as follows:

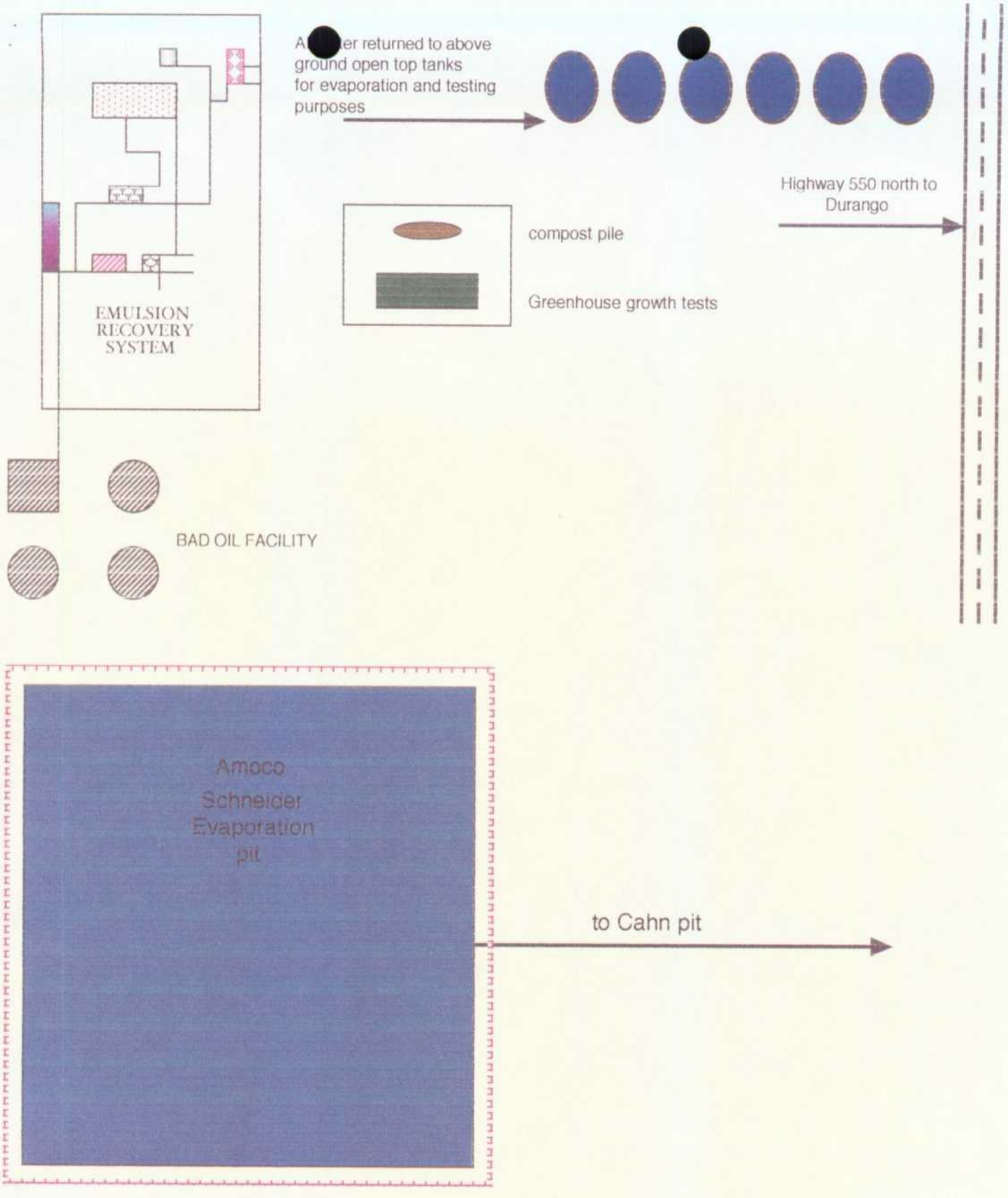
- EERC - John Harju, Dan Stepan
- B.C. Technologies - John Boysen

Electrovap Description



The electrolytes stick to the charged nozzles and build up the slurry. The slurry is recovered at the bottom and removed for separation of NaCl and other minerals.

Drawn by Jerry Finney 8-7-95 for Tom Taylor-inventor, for Amoco confidential for V.C. & N.V.S. only.



Drawn by Sam Merrill and Melissa MacDowell of The Secreatry, idea and dictation by Jerry Finney, 6/17/95. Confidential and for V.C. or N.V.S. and their client use only.

Explanation of Emulsion Recovery System

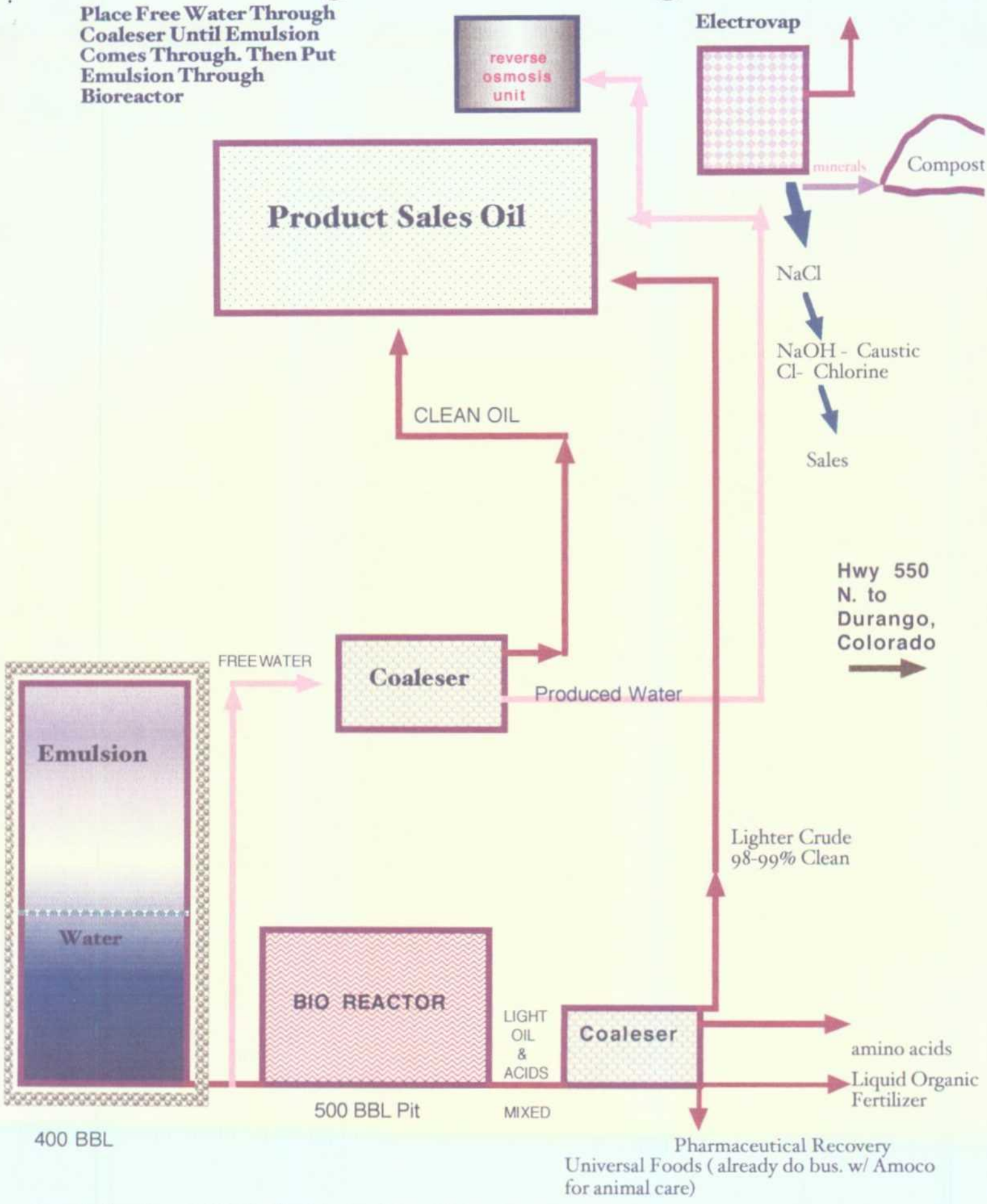
Pit emulsions are placed in the 400 BBL tank and allowed to stand a few hours. The free water on the bottom of the tank is drained and the water flows through the Mctighe coaleser to remove any oil. The oil flows to a product sales tank for storage. The water which is high in TDS flows to the Electrovap and R.O. unit for desalinization. After Electrovap and R.O. the minerals are separated from the sodium chloride according to its solubility curve. The clean water (1000 ppm TDS or less) will be stored in an above ground tank until the BTEX levels and TDS are shown to be reduced. After confirmation of purity, the water will be used to irrigate crops for growth tests. Back to the minerals, after removal of the Sodium Chloride, the remaining minerals can either be utilized in the liquid fertilizers from the bio-reactor or in the solid fertilizers in the compost pile. The Sodium Chloride will be processed by electrolytic dialysis into Chlorine gas and Sodium Hypochlorite for recovery.

When the free water is drained off, the emulsion will be placed into the top of the 500 bbl steel pit filled with sand and inoculated with water, microbes, and nutrients. The emulsion will be placed evenly over the top and allowed to percolate through the sand and be converted to lighter crude and amino acids. These materials will be drained from the bottom of the reactor and flowed through a coaleser to recover the crude for sale and the amino acids for sale as pharmaceutical products or as liquid organic fertilizers. Produced water may also be drawn from the Schneider evaporation pond and processed for desalinization only. All water will be tanked and checked for purity and used in green house or placed in above ground open topped tanks for evaporation.

Drawn bySam Merrill and Melissa Macdowell of The Secretary, dictated and idea by Jerry Finney, 6-17-95

EMULSION RECOVERY SYSTEM

Place Free Water Through Coaleser Until Emulsion Comes Through. Then Put Emulsion Through Bioreactor

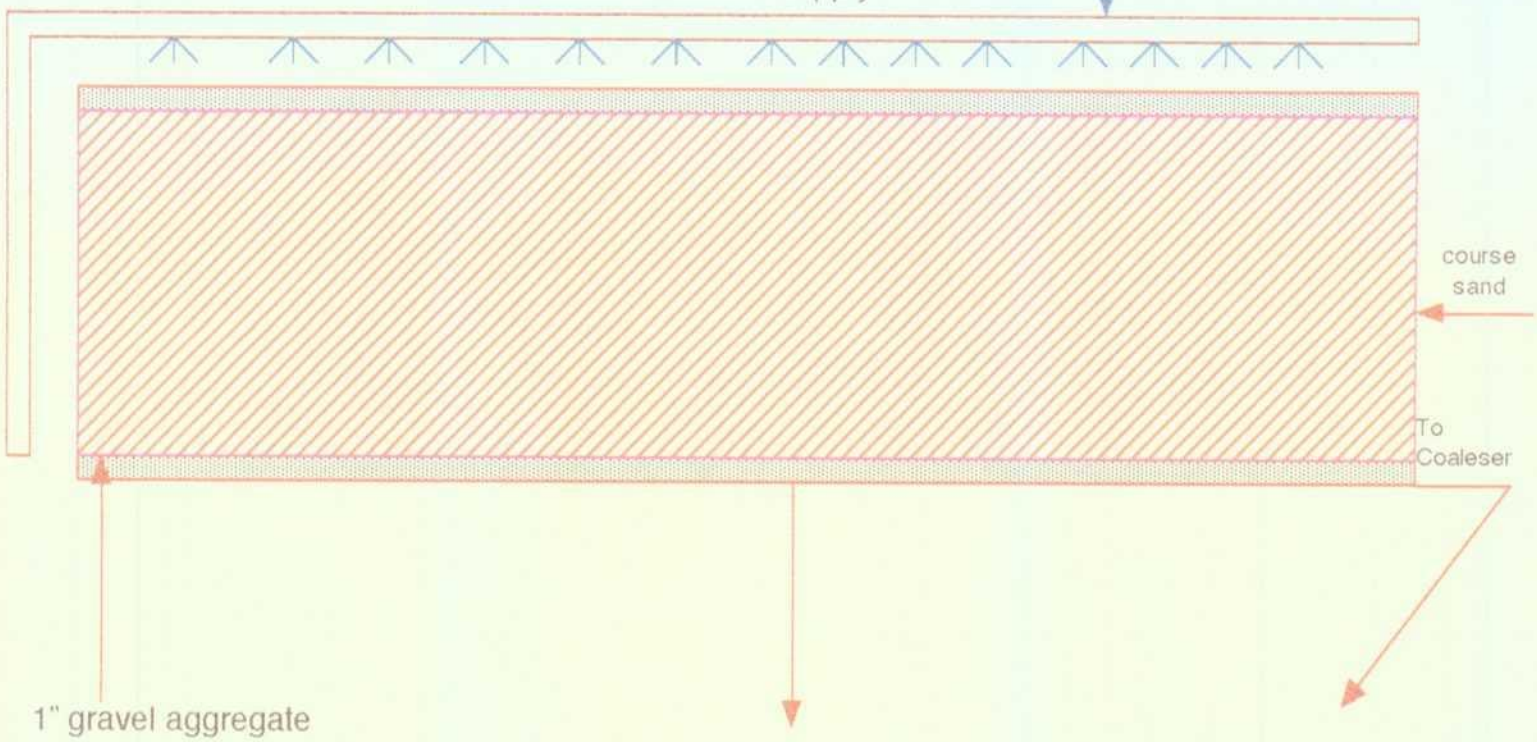


Drawn by Jerry Finney 6-17-95 Confidential and for V.C. or N.V.S. and their clients use only.

Bio Reactor Cross Section

Capacity - 40 to 50 BBLs./Day emulsion
Recover @ 25 - 30 BBL/Oil/Day and 20 BBL.
Fertilizer and Amino Acids for Agricultural use.
See Irvine Analytical Laboratory results.

Emulsion is sprayed on top of 1" gravel in 10 minute spurts per hour



Nutrients added will be 45-0-0 Urea @ 10 lbs day.

Drawn by Jerry Finney 8/7/95 for Amoco use only based on proprietary data confidential and for V.C. & N.V.S. and their clients.

If you have any questions call me at (505) 827-7153.

Sincerely,

Chris Eustice
Geologist

cc: OCD Aztec Office