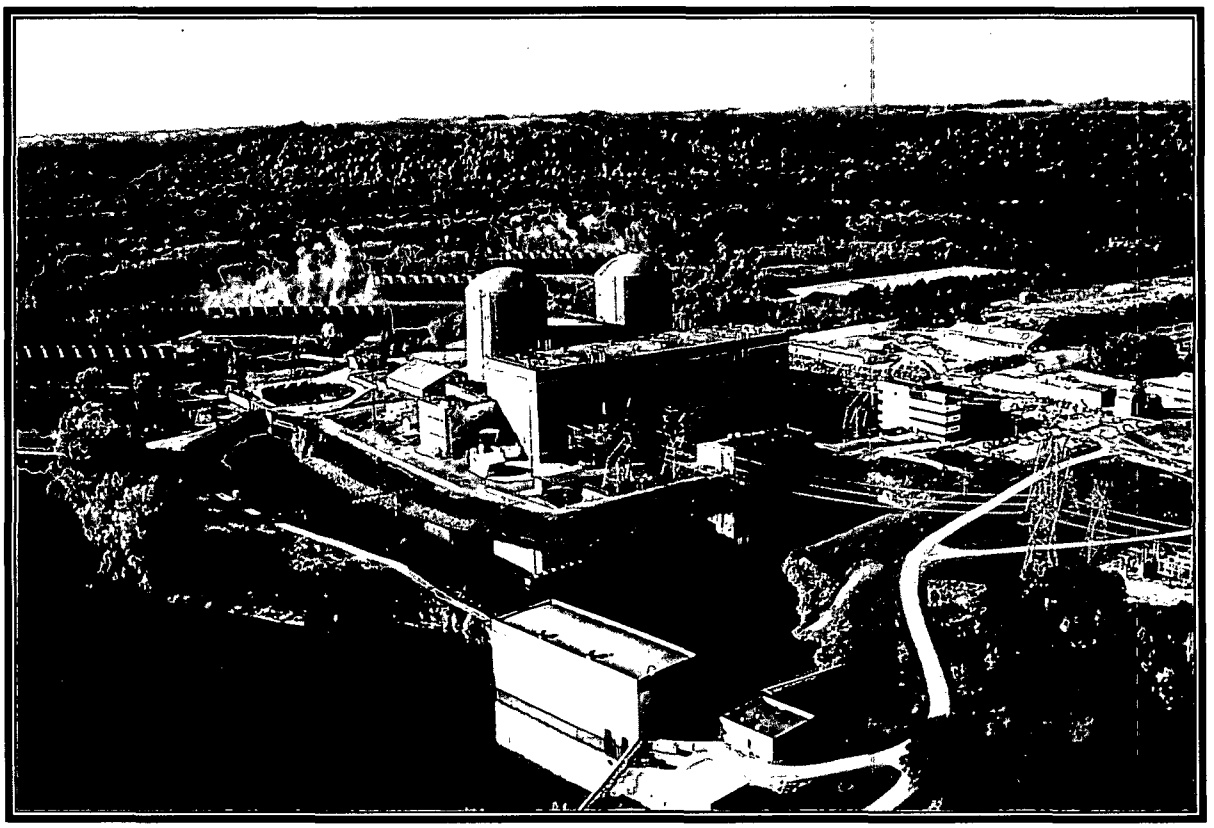
Xcel Energy

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

LICENSE RENEWAL ENVIRONMENTAL REPORT ADDITIONAL INFORMATION



Documents Requested During NRC Environmental Review

Environmental Health & Waste Issues

Binder 1 of 1

Item Number	Document	Reasoning
Kate Lenning		
1	PROPRIETARY - Follow-up to questions from Kate Lenning (typed responses) - Submitted under separate transmission	Privileged and Confidential
2	PROPRIETARY - Waste Management Program Procedure/Waste Management Guidance Manual - Submitted under separate transmission	Internal Procedure - Copyright
3	PROPRIETARY - Environmental Management Baseline: Pages 18,22-25, 28-32, 36-37 - Submitted under separate transmission	Internal Procedure - Copyright
4	PROPRIETARY - Domestic Water and Sewer System, Rev. 7 - Submitted under separate transmission	Internal Procedure - Copyright
5	2004 Hazardous Waste License Application	Public
6	2005 Hazardous Waste License Application	Public
7	2006 Hazardous Waste License Application	Public
8	2007 Hazardous Waste License Application	Public
9	2008 Hazardous Waste License Application	Public
10	PROPRIETARY - Regulated Waste Management & Hazardous and Non-Hazardous Materials Storage, Disposal and Labeling Requirements - Submitted under separate transmission	Internal Procedure - Copyright
11	Minnesota Emergency Response Commission. Hazardous Chemical Report. 2008. (EPA 2007)	Public
12	Minnesota Emergency Response Commission. Hazardous Chemical Report. 2007. (EPA 2006)	Public
13	Minnesota Emergency Response Commission. Hazardous Chemical Report. 2006. (EPA 2005)	Public
14	Air Emission System Permit 04900030-003 with tables and Appendix B	Public
15	PROPRIETARY - 2007 MIDAS Data Performance Tracking - Submitted under separate transmission	Privileged and Confidential
16	PROPRIETARY - 2008 Meterological Performance Data - Submitted under separate transmission	Privileged and Confidential
17	Air Quality Binder #2: Climate of MN	Public
18	Air Quality Binder #2: Wind roses	Public
19	Air Quality Binder #2: Query results	Public
20	PROPRIETARY - "Public Exposure Impact" from SGR-Related Additional Information Binder - Submitted under separate transmission	Privileged and Confidential
21	PROPRIETARY -Projected dose to workers during SGR project - Submitted under separate transmission	Privileged and Confidential
22	PROPRIETARY - Projected increase in radiological waste during SGR project - Submitted under separate transmission	Privileged and Confidential
23	*Guidelines for operating an interim on site low-level radioactive waste storage facility* 2/12/08, public version	Public
24	PROPRIETARY - Interim storage of low and intermediate level wastes: Guidelines for extended storage. Technical Report, EPRI - Submitted under separate transmission	Internal Procedure - Copyright
25	PROPRIETARY - Email from J.L. Payton to R.L. Vincent, Subj: REMP anomalies for last 5 yrs - Submitted under separate transmission	Privileged and Confidential

(5)

Hazardous Waste License Application

Minnesota Pollution Control Agency, MAR/Majors, 520 Lafayette Road N, St. Paul, MN 55155

Office Use Only
Core/Active
CD
WH
PM
FP
NAICS Code
Tax ID

Check box and complete parts 2 and 3 if applicable.

☒ Less than 10 gal (100 lbs) / year

☐ Out of Business as of: (date) _____

Location Address

1. MND049537780
2. Xcel Energy - Prairie Island Nuclear Plt
3. 1717 Wakonade Dr E
   Welch, MN 55089
4. Goodhue County

Mailing Address

5. JUDY GRANT
   XCEL ENERGY - PRAIRIE ISLAND NUCLEAR PLT
   ~~1717 WAKONADE DR E~~ 414 Nicollet mall - RS8
   ~~WELCH, MN 55089~~ Minneapolis, mn 55401

6. Judy Grant 7. 612/330-2861
8. Tax ID: 4886397
9. Business Type Description:
   NAICS Code: 221113
   SIC CODE: 4911

Generator Size: Generation, SQG

Part 1- General Information CORRECTIONS ONLY

1. **Generator ID#** _____
   (If you updated the generator ID#, complete Part 1a on last page of this form.)
2. **Company Name** _____
3. **Location Address** _____
   (If you updated the location Address, complete Part 1b on last page of this form.)
4. **Location County** _____
5. **Mailing Address** 414 Nicollet mall - RS8
   Minneapolis, MN 55401
6. **Contact Person** _____
   (Contact person must sign in Part 3 on last page of this form.)
7. **Telephone Number** ( ) -
8. **Minnesota or Federal Tax ID#:** 4886397
9. **Business Type Description** *Check the box at the right and complete part 1c on the last page of this form if your NAICS and/or SIC code is not preprinted in box 9 at the left. See last page for complete instructions.* ☐

Part 2 - Waste Stream Information for 2003

INSTRUCTIONS: Complete one form for each location. Fill out the shaded area for each waste produced during 2003. Put a line through wastes no longer produced. For wastes not preprinted below: If you are a Very Small Quantity Generator, add the wastes to the list after the last preprinted item. If you are a Large or Small Quantity Generator, complete a Management Plan Short Form for each new waste.
See Application Instructions for details. Return form by Feb 07, 2004.

Inventory #	Waste Code (2- 0r 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2003 Amount: Write in the amount and check gallons or pounds at the right.	Gal	Lbs	Mgmt Method
Wastes previously reported on 2002 report:									
001	D001	SOLVENT, NON HALOGENATED	586	P	BF	11		X	BF
002	MN02	SEWERED LAB WASTE	75	P	SG	95		X	SG
003	D039	SOLVENT, HALOGENATED	15	P	BF	0			
004	MN02	CHEMICAL, FORMALDEHYDE	0	P	IT	0			
006	MN03	MINERAL OIL, PCB	0	P	IT	0			
007	D001	PAINT RELATED MATERIAL	2011	P	BF	1392		X	BF
011	D008	USED OIL, GREASE	0	G	RB	0			
012	D007	WOOD PRESERVATIVE	0	P	IT	0			
013	D007	HAZARDOUS WASTE SOLID, METAL	757	P	BF	1410		X	mm
014	D002	CORROSIVE LIQUID	81	P	MM	3920		X	mm
015	D022	EXPIRED CHEMICALS, HAZARDOUS	0	P	IT	115		X	mm
016	D007	WATER, METAL CONTAMINATED	170	P	MM	592		X	mm
018	D001	AEROSOLS	60	P	BF	45		X	BF
019	MN03	ELECTRICAL EQUIPMENT, PCB	0	P	LD	0			
~~021~~	~~F002~~	~~Rags and Sorbents, Solvent Contaminated~~	~~138~~	~~P~~	~~BF~~				
023	MN01	CORROSIVE SOLIDS	0	P	SZ	31		X	SZ
024	D001	OXIDIZER, LIQUID	0	P	SZ	0			
025	MN01	BORON TRIFLUORIDE	0	P	IT	0			

Part 2 - Waste Stream Information for 2003 Continued

Inventory #	Waste Code (2- or 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2003 Amount			
						Write in the amount and check gallons or pounds at the right	Gal	Lbs	Mgmt Method
Wastes previously reported on 2002 report:									
026	MN03	PCB Solids	1	P	LD			⊘	

General Information Explanations: Complete this section only if you have made changes to Part 1.

Part 1a: Changes to line 1, Generator ID#

Please indicate why the generator ID# was corrected:

- ☐ Duplicate ID# for the same site *(Be sure to verify that location addresses are the same)*
- ☐ EPA ID# was obtained *(write EPA ID# here.)* _____
- ☐ Moved/Changed locations *(Complete 'Part 1b' below.)*
- ☐ No ID# on front of form _____
- ☐ Other *(explain):* _____

Part 1b: Changes to line 3, Location Address

Please indicate why the location address was corrected:

- ☐ Moved waste generating activities to another location. *Complete a "Notification of Regulated Waste Activity Form" for the new location, if you haven't already done so, and submit the completed form with your completed License Application; a new ID# will be issued for the new location. The "Notification of Regulated Waste Activity Form" is available on-line at* www.pca.state.mn.us/publications/w-hw7-09.pdf.
- ☐ Streets and/or street numbers changed by 911 (Emergency) System.
- ☐ Property incorporated into city limits and street was renamed.
- ☐ Incorrect address; never at site address listed on front.
- ☐ Not a change in location; just a clarification of the address on the front.
- ☐ Other *(explain):* _____

Part 1c: Business Type Description. Find your NAICS code by going to www.census.gov/epcd/www/naics.html.

The passage of the North American Free Trade Agreement (NAFTA) mandated a change in the system that identifies and classifies businesses and industries. The previous system, known as the Standard Industrial Classification (SIC) System, has been replaced by the North American Industry Classification System (NAICS), which is more comprehensive. Please log on to www.census.gov/epcd/www/naics.html to look up your NAICS code and/or convert your SIC code, which is preprinted on the front page of this application, to the appropriate NAICS code. If you do not have access to the internet and your SIC code is not preprinted on the front page of the applicaation, please provide a brief explanation of your business or the services you provide and staff will assign an appropriate NAICS code. _____

Part 3 - Read and Sign Certification Below.

Check a box below if applicable. Keep a copy of your completed license application for at least 3 years.
Mail the original, completed application to the MPCA at the address below.

- ☐ My business produces less than 10 gallons of waste per year.
- ☐ My business does not generate a hazardous waste at the location address on the front of this form.
- ☐ My business no longer operates at the location address on the front.

Certification:
I certify under penalty of law that I have personally examined and am familiar with the information contained in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature _____ Name *(please print)* Judy Grant Date 1/30/2004

You Can Request Additional Information... visit our web site at www.pca.state.mn.us/waste/pubs/business.html.

- ☐ Please send me more information on the *Special Waste Pilot Project (#2.22) (www.pca.state.mn.us/publications/w-hw2-22).*
- ☐ Please send me more information on VSQG Collection Sites (#2.51) (www.pca.state.mn.us/publications/w-hw2-51.pdf).
- ☐ Please send me a listing of the fact sheets available on complying with the Hazardous Waste Rules (#0.00) (www.pca.state.mn.us/publications/w-hw0-00.pdf).
- ☐ *Pollution Prevention* can save your business time and money. Non-regulatory programs can be contacted at the numbers below to learn more about the Pollution Prevention opportunities available to you. If you would like to be contacted by the Minnesota Technical Assistance Program (612/624-1300) please check the box at the left.

Return this application by Feb 07, 2004 to:

Minnesota Pollution Control Agency, MAR/Majors

520 Lafayette Road N., St. Paul, Minnesota 55155-4194

Hazardous Waste License Application

Minnesota Pollution Control Agency, MAR/Majors, 520 Lafayette Road N, St. Paul, MN 55155

Office Use Only
Core/Active
CD
WH
PM
FP
NAICS Code
Tax ID

Check box and complete parts 2 and 3 if applicable

☐ Less than 10 gal (100 lbs) / year

☐ Out of Business as of: (date)_____

Location Address

1. MND049537780
2. Xcel Energy - Prairie Island Nuclear Plt
3. 1717 Wakonade Dr E
   Welch, MN 55089
4. Goodhue County

Mailing Address

5. JUDY GRANT
   XCEL ENERGY - PRAIRIE ISLAND NUCLEAR PLT
   ~~414 NICOLLET MALL~~
   MINNEAPOLIS, MN ~~55401-1999~~

6. Judy Grant 7. 612/~~330-2864~~
8. Tax ID:
9. Business Type Description:
   NAICS Code: 221113
   SIC CODE: 4911

Generator Size: Generation, SQG

Part 1- General Information CORRECTIONS ONLY

1. Generator ID#
   (If you updated the generator ID#, complete Part 1a on last page of this form.)
2. Company Name
3. Location Address
   (If you updated the location Address, complete Part 1b on last page of this form.)
4. Location County
5. Mailing Address 1518 Chestnut Ave. (HOSF)
   Minneapolis, MN 55403
6. Contact Person
   (Contact person must sign in Part 3 on last page of this form.)
7. Telephone Number (612) 630 - 4519
8. Minnesota or Federal Tax ID#: 4886390
9. Business Type Description *Check the box at the right and complete part 1c on the last page of this form if your NAICS and/or SIC code is not preprinted in box 9 at the left. See last page for complete instructions.* ☐

Part 2 - Waste Stream Information for 2004

INSTRUCTIONS: Complete one form for each location. Fill out the shaded area for each waste produced during 2004. Put a line through wastes no longer produced. For wastes not preprinted below: If you are a Very Small Quantity Generator, add the wastes to the list after the last preprinted item. If you are a Large or Small Quantity Generator, complete a Management Plan Short Form for each new waste.

See Application Instructions for details. Return form by Feb 01, 2005.

Inventory #	Waste Code (2- or 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2004 Amount Write in the amount and check gallons or pounds at the right	Gal	Lbs	Mgmt Method
Wastes previously reported on 2003 report:									
001	D001	SOLVENT, NON HALOGENATED	11	P	BF	155		X	BF
002	MN02	SEWERED LAB WASTE	75	P	SG	75		X	SG
003	D039	SOLVENT, HALOGENATED	0	P	IT	0			
004	MN02	CHEMICAL, FORMALDEHYDE	0	P	IT	0			
006	MN03	MINERAL OIL, PCB	0	P	IT	0			
007	D001	PAINT RELATED MATERIAL	1372	P	BF	1011		X	BF
011	D008	USED OIL, GREASE	0	G	RB	0			
012	D007	WOOD PRESERVATIVE	0	P	IT	0			
013	D006	HAZARDOUS WASTE SOLID, METAL	1410	P	MM	1215		X	mm
014	D002	CORROSIVE LIQUID	3720	P	MM	589		X	mm
015	D022	EXPIRED CHEMICALS, HAZARDOUS	115	P	MM	61		X	mm
016	D007	WATER, METAL CONTAMINATED	572	P	MM	512		X	mm
018	D001	AEROSOLS	45	P	BF	104		X	BF
019	MN03	ELECTRICAL EQUIPMENT, PCB	0	P	LD	0			
02[illegible]	MN01	CORROSIVE SOLIDS	31	P	SZ	0			
02[illegible]	D001	OXIDIZER, LIQUID	0	P	SZ	0			
025	MN01	BORON TRIFLUORIDE	0	P	IT	0			
026	MN03	PCB Solids	0	P	LD	0			

Part 2 - Waste Stream Information for 2004 Continued

Inventory #	Waste Code (2- 0r 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2004 Amount Write in the amount and check gallons or pounds at the right	Gal	Lbs	Mgmt Method
Wastes previously reported on 2003 report:									
~~027~~	~~F002~~	~~Rags and Sorbents Solvent~~	~~14~~	~~P~~	~~BF~~				
~~028~~	~~D011~~	~~Hazardous Waste Solid Silver~~	~~50~~	~~P~~	~~IT~~				

General Information Explanations: Complete this section only if you have made changes to Part 1.

Part 1a: Changes to line 1, Generator ID#

Please indicate why the generator ID# was corrected:

- ☐ Duplicate ID# for the same site *(Be sure to verify that location addresses are the same)*
- ☐ EPA ID# was obtained *(write EPA ID# here.)* _____
- ☐ Moved/Changed locations *(Complete **'Part 1b'** below.)*
- ☐ No ID# on front of form _____
- ☐ Other *(explain)*: _____

Part 1b: Changes to line 3, Location Address

Please indicate why the location address was corrected:

- ☐ Moved waste generating activities to another location. *Complete a "Notification of Regulated Waste Activity Form" for the new location, if you haven't already done so, and submit the completed form with your completed License Application; a new ID# will be issued for the new location. The "Notification of Regulated Waste Activity Form" is available on-line at www.pca.state.mn.us/publications/w-hw7-09.pdf.*
- ☐ Streets and/or street numbers changed by 911 (Emergency) System.
- ☐ Property incorporated into city limits and street was renamed.
- ☐ Incorrect address; never at site address listed on front.
- ☐ Not a change in location; just a clarification of the address on the front.
- ☐ Other *(explain)*: _____

Part 1c: Business Type Description. Find your NAICS code by going to www.census.gov/epcd/www/naics.html.

The passage of the North American Free Trade Agreement (NAFTA) mandated a change in the system that identifies and classifies businesses and industries. The previous system, known as the Standard Industrial Classification (SIC) System, has been replaced by the North American Industry Classification System (NAICS), which is more comprehensive. Please log on to www.census.gov/epcd/www/naics.html to look up your NAICS code and/or convert your SIC code, which is preprinted on the front page of this application, to the appropriate NAICS code. If you do not have access to the internet and your SIC code is not preprinted on the front page of the applicaation, please provide a brief explanation of your business or the services you provide and staff will assign an appropriate NAICS code. _____

Part 3 - Read and Sign Certification Below.

Check a box below if applicable. Keep a copy of your completed license application for at least 3 years.
Mail the original, completed application to the MPCA at the address below.

- ☐ My business produces less than 10 gallons of waste per year.
- ☐ My business does not generate a hazardous waste at the location address on the front of this form.
- ☐ My business no longer operates at the location address on the front.

Certification:

I certify under penalty of law that I have personally examined and am familiar with the information contained in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature _____ Judy Grant (Name *(please print)*) 2/1/2005 (Date)

You Can Request Additional Information... visit our web site at www.pca.state.mn.us/waste/pubs/business.html.

- ☐ Please send me more information on the *Special Waste Pilot Project (#2.22) (www.pca.state.mn.us/publications/w-hw2-22).*
- ☐ Please send me more information on VSQG Collection Sites (#2.51) (www.pca.state.mn.us/publications/w-hw2-51.pdf).
- ☐ Please send me a listing of the fact sheets available on complying with the Hazardous Waste Rules (#0.00) (www.pca.state.mn.us/publications/w-hw0-00.pdf).
- ☐ *Pollution Prevention* can save your business time and money. Non-regulatory programs can be contacted at the numbers below to learn more about the Pollution Prevention opportunities available to you. If you would like to be contacted by the Minnesota Technical Assistance Program (612/624-1300) please check the box at the left.

Return this application by Feb 01, 2005 to:

Minnesota Pollution Control Agency, MAR/Majors

520 Lafayette Road N., St. Paul, Minnesota 55155-4194

Hazardous Waste License Application

(to report hazardous waste generated last calendar year, as required by law)

Minnesota Pollution Control Agency, 520 Lafayette Road N, St. Paul, MN 55155

Office Use Only 7

Core/Active
CD
WH
PM
FP
NAICS Code
Tax ID

Check box and complete parts 2 and 3 if applicable.

☐ Less than 10 gal (100 lbs) / year

☐ Out of Business as of: (date)_____

* note: You must report the amount you generated in the last calendar year even if it's zero.

Location Address

1. MND049537780
2. Xcel Energy - Prairie Island Nuclear Plt
3. 1717 Wakonade Dr E
   Welch, MN 55089
4. Goodhue County

Mailing Address

5. JUDY GRANT
   XCEL ENERGY - PRAIRIE ISLAND NUCLEAR PLT
   ~~414 NICOLLET MALL~~ 1518 Chestnut Ave. (hazwaste)
   MINNEAPOLIS, MN ~~55401-1993~~ 55403

6. Judy Grant 7. 612/630-4519

8. Fed. Tax ID: 411967505 MN Tax ID: 8133673

9. Business Type Description:
   NAICS code: 221113, Nuclear Electric Power Generation
   SIC code: 4911, Electric services

Generator Size: Generation, SQG

Part 1- General Information CORRECTIONS ONLY

1. **Generator ID#** _____
   (If you updated the generator ID#, complete Part 1a on last page of this form.)
2. **Company Name** _____
3. **Location Address** _____
   (If you updated the location Address, complete Part 1b on last page of this form.)
4. **Location County** _____
5. **Mailing Address** 1518 Chestnut Ave (hazwaste)
   minneapolis, MN 55403
6. **Contact Person** _____
   (Contact person must sign in Part 3 on last page of this form.)
7. **Telephone Number** ( ) -
8. **Tax ID: Review and correct if necessary**
9. **Business Type Description** *Check the box at the right and complete part 1c on the last page of this form if your NAICS and/or SIC code is not preprinted in box 9 at the left. See last page for complete instructions.* ☐

Part 2 - Waste Stream Information for 2005

INSTRUCTIONS: You must complete one form for each location. Fill out the shaded area for each waste generated during 2005. Put a line through wastes no longer generated. For wastes not preprinted below: If you are a Very Small Quantity Generator, add the wastes to the list after the last preprinted item. If you are a Large or Small Quantity Generator, complete a Management Plan Short Form for each new waste. **Reminder:** If you generated parts washer solvent that was hazardous, you must report it, even if you mix it with used oil or have it hauled off-site under contract.

See Application Instructions for details. Return form by Jan 30, 2006.

Inventory #	Waste Code (2- or 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2005 Amount: Write in the amount and check gallons or pounds at the right.	Gal	Lbs	Mgmt Method
Wastes previously reported on 2004 report:									
001	D001	SOLVENT, NON HALOGENATED	155	P	BF	298		X	mm
002	MN02	SEWERED LAB WASTE	75	P	SG	75		X	SG
003	D039	SOLVENT, HALOGENATED	0	P	IT	0			
004	MN02	CHEMICAL, FORMALDEHYDE	0	P	IT	0			
006	MN03	MINERAL OIL, PCB	0	P	IT	0			
007	D001	PAINT RELATED MATERIAL	1011	P	BF	1990		X	BF
011	D008	USED OIL, GREASE	0	G	RB	0			
012	D007	WOOD PRESERVATIVE	0	P	IT	0			
013	D006	HAZARDOUS WASTE SOLID, METAL	1215	P	MM	1388		X	mm
014	D002	CORROSIVE LIQUID	589	P	MM	37		X	mm
015	~~D022~~ MN02	EXPIRED CHEMICALS, HAZARDOUS	61	P	MM	389		X	mm
	D007	WATER, METAL CONTAMINATED	512	P	MM	226		X	mm
018	D001	AEROSOLS	104	P	BF	43		X	BF
019	MN03	ELECTRICAL EQUIPMENT, PCB	0	P	LD	0			
023	MN01	CORROSIVE SOLIDS	0	P	SZ	0			

Part 2 - Waste Stream Information for 2005 Continued

Inventory #	Waste Code (2- 0r 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2005 Amount *Write in the amount and check gallons or pounds at the right*	Gal	Lbs	Mgmt Method
Wastes previously reported on 2004 report:									
024	D001	OXIDIZER, LIQUID	0	P	SZ				
025	MN01	BORON TRIFLUORIDE	0	P	IT				
026	MN03	PCB Solids	0	P	LD				

General Information Explanations: Complete this section only if you have made changes to Part 1.

Part 1a: Changes to line 1, Generator ID#

Please indicate why the generator ID# was corrected:

- ☐ EPA ID# was obtained *(write EPA ID# here:)* _____
- ☐ Moved/Changed locations *(Complete **'Part 1b'** below.)*
- ☐ No ID# on front of form _____
- ☐ Other *(explain):* _____

Part 1b: Changes to line 3, Location Address

Please indicate why the location address was corrected:

- ☐ Moved waste generating activities to another location. *You must complete a "Notification of Regulated Waste Activity Form" for the new location, if you haven't already done so, and submit the completed form with your completed License Application; a new ID# will be issued for the new location. The "Notification of Regulated Waste Activity Form" is available on-line at* www.pca.state.mn.us/publications/w-hw7-09.pdf.
- ☐ Streets and/or street numbers changed by 911 (Emergency) System.
- ☐ Property incorporated into city limits and street was renamed.
- ☐ Incorrect address; never at site address listed on front.
- ☐ Not a change in location; just a clarification of the address on the front.
- ☐ Other *(explain):* _____

Part 1c: Business Type Description. Find your NAICS code by going to www.census.gov/epcd/www/naics.html.

The passage of the North American Free Trade Agreement (NAFTA) mandated a change in the system that identifies and classifies businesses and industries. The previous system, known as the Standard Industrial Classification (SIC) System, has been replaced by the North American Industry Classification System (NAICS), which is more comprehensive. Please log on to **www.census.gov/epcd/www/naics.html** to look up your NAICS code and/or convert your SIC code, which is preprinted on the front page of this application, to the appropriate NAICS code. If you do not have access to the internet and your SIC code is not preprinted on the front page of the application, please provide a brief explanation of your business or the services you provide and staff will assign an appropriate NAICS code. _____

Part 3 - Read and Sign Certification Below.

Check a box below if applicable. Keep a copy of your completed license application for at least 3 years.

Mail the original, completed application to the MPCA at the address below.

- ☐ My business produces less than 10 gallons of waste per year.
- ☐ My business does not generate a hazardous waste at the location address on the front of this form.
- ☐ My business no longer operates at the location address on the front, and did not generate more than 10 gallons of waste during 2005.

Certification:

I certify under penalty of law that I have personally examined and am familiar with the information contained in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature _____ Name *(please print)* Judy Grant Date 1/30/2006

You Can Request Additional Information... visit our web site at www.pca.state.mn.us/waste/pubs/business.html for lots of information on hazardous waste rules and regulations.

- ☐ Please send me more information on VSQG Collection Sites (#2.51) (www.pca.state.mn.us/publications/w-hw2-51.pdf).
- ☐ Please send me a listing of the fact sheets available on complying with the Hazardous Waste Rules (#0.00) (www.pca.state.mn.us/publications/w-hw0-00.pdf).

Return this application by Feb 08, 2006 to:

Minnesota Pollution Control Agency

520 Lafayette Road N., St. Paul, Minnesota 55155-4194

Hazardous Waste License Application

(to report hazardous waste generated last calendar year, as required by law)

Minnesota Pollution Control Agency, 520 Lafayette Road N, St. Paul, MN 55155

Part 1 General Information

Generator ID #

1. MND049537780

Mailing Address

2. JUDY GRANT
3. XCEL ENERGY - PRAIRIE ISLAND NUCLEAR PLT
4. ~~1519 CHESTNUT AVE~~ ~~MINNEAPOLIS, MN 55403~~

Location Address

5. 1717 Wakonade Dr E Welch, MN 55089
6. Goodhue County

Judy Grant 7. ~~612/630-4519~~

8. Fed. Tax ID: 411967505 MN Tax ID: 4886397

9. Business Type Description:
NAICS code: 221113, Nuclear Electric Power Generation

Generator Size: Generation, SQG

CORRECTIONS ONLY

1. Generator ID#
(If you updated the generator ID#, complete Part 1a on last page of this form.)
2. Contact Person
(Contact person must sign in Part 3 on last page of this form.)
3. Company Name
4. Mailing Address 250 Marquette Ave., Suite 800 Minneapolis, MN 55401
5. Location Address
(If you updated the location Address, complete Part 1a on last page of this form.)
6. Location County
7. Telephone Number (612) 330-9829
8. Tax ID: Review and correct if necessary
9. Business Type Description *Check the box at the right and complete part 1b on the last page of this form if your NAICS and/or SIC code is not preprinted in box 9 at the left. See last page for complete instructions.* ☐

Check box and complete parts 2 and 3 if applicable.

☐ Less than 10 gal (100 lbs) / year

☐ Intermittent Generator: Check if you did not generate waste this year but might next year.

☐ Out of Business as of: (date)_____

* note: You must report the amount you generated in the last calendar year even if it's zero.

Part 2 - Waste Stream Information for 2006

INSTRUCTIONS: You must complete one form for each location. Record the amount for each waste generated during 2006. Put a line through wastes no longer generated. For wastes not preprinted below: If you are a Very Small Quantity Generator, add the wastes to the list after the last preprinted item. If you are a Small or Large Quantity Generator, complete a Management Plan Short Form for each new waste.
Reminder: If you generated parts washer solvent that was hazardous, you **MUST** report it, even if you mix it with used oil or have it hauled off-site under contract.

See Application Instructions for details. Return form by Feb 07, 2007. Please report: P = Pounds, G = Gallons, K = Kilograms

Inventory #	Waste Code (2- or 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2006 Amount: Write in the amount and indicate pounds, gallons, or kilograms at the right.	P, G, or K	Mgmt Method
Wastes previously reported on 2005 report:								
001	D001	SOLVENT, NON HALOGENATED	298	P	MM	59	P	BF
002	MN02	SEWERED LAB WASTE	75	P	SG	75	P	SG
003	D039	SOLVENT, HALOGENATED	0	P	IT	0		
004	MN02	CHEMICAL, FORMALDEHYDE	0	P	IT	80	P	IT
006	MN03	MINERAL OIL, PCB	0	P	IT	0		
007	D002	PAINT RELATED MATERIAL	1990	P	BF	1718	P	BF
011	D008	USED OIL, GREASE	0	G	RB	0		
012	D007	WOOD PRESERVATIVE	0	P	IT	0		
013	D006	HAZARDOUS WASTE SOLID, METAL	1388	P	MM	1575	P	mm
014	D002	CORROSIVE LIQUID	37	P	MM	537	P	mm
015	MN02	EXPIRED CHEMICALS, HAZARDOUS	389	P	MM	23	P	mm
016	D007	WATER, METAL CONTAMINATED	226	P	MM	901	P	mm
018	D001	AEROSOLS	43	P	BF	37	P	BF

Waste Stream Information for 2006 Continued

Please report: P = Pounds, G = Gallons, K = Kilograms

...ory	Waste Code (2- or 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2006 Amount: Write in the amount and indicate pounds, gallons, or kilograms at the right	P, G, or K	Mgmt Method
Wastes previously reported on 2005 report:								
9	MN03	ELECTRICAL EQUIPMENT, PCB	0	P	LD	446	P	LD
023	MN01	CORROSIVE SOLIDS	0	P	SZ	0		
024	D001	OXIDIZER, LIQUID	0	P	SZ	0		
025	MN01	BORON TRIFLUORIDE	0	P	IT	0		
026	MN03	PCB Solids	0	P	LD	0		

Hazardous Waste License Application

(to report hazardous waste generated last calendar year, as required by law)

Office Use Only
Core Active
CD
WH
PM
FP
NAICS Code
Tax ID

Part 1- General Information

Generator ID #

1. MND049537780

Mailing Address

2.
3. XCEL ENERGY - PRAIRIE ISLAND NUCLEAR PLT
4. ~~250 MARQUETTE PLAZA MP8~~
   MINNEAPOLIS, MN 55401

Location Address

5 1717 Wakonade Dr E
Welch, MN 55089

6. Goodhue County

Judy Grant 7. 612/330-7827

8. Fed. Tax ID: 411967505 MN Tax ID: 4886397

9. Business Type Description:
NAICS code: 221113, Nuclear Electric Power Generation

Generator Size: Generation, SQG

CORRECTIONS ONLY

1. Generator ID# _____
(If you updated the generator ID#, complete Part 1a on last page of this form.)
2. Contact Person Judy Grant
(Contact person must sign in Part 3 on last page of this form.)
E-mail Address judy.g.grant@xcelenergy.com
3. Company Name _____
4. Mailing Address 250 Marquette Ave., Suite 800
5. Location Address _____
(If you updated the location Address, complete Part 1a on last page of this form.)
6. Location County _____
7. Telephone Number ( ) -
8. Tax ID: Review and correct if necessary
9. Business Type Description *Check the box at the right and complete part 1b on the last page of this form if your NAICS and/or SIC code is not preprinted in box 9 at the left. See last page for complete instructions.* ☐

Check box and complete parts 2 and 3 if applicable.

☐ Less than 10 gal (100 lbs) / year

☐ Intermittent Generator: Check if you did not generate waste this year but might next year.

☐ Out of Business as of: (date)_____

* Note: You must report the amount you generated in the last calendar year even if it's zero.

Part 2 - Waste Stream Information for 2007

INSTRUCTIONS: You must complete one form for each location. Record the amount for each waste generated during 2007. Put a line through wastes no longer generated. For wastes not preprinted below: If you are a Very Small Quantity Generator, add the wastes to the list after the last preprinted item. If you are a Small or Large Quantity Generator, complete a Management Plan Short Form for each new waste.
Reminder: If you generated parts washer solvent that was hazardous, you MUST report it, even if you mix it with used oil or have it hauled off-site under contract.

See Application Instructions for details. Return form by January 27, 2008. Please report: P = Pounds, G = Gallons, K = Kilograms

Inventory #	Waste Code (2- or 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2007 Amount: Write in the amount and indicate pounds, gallons, or kilograms at the right.	P, G, or K	Mgmt Method
Wastes previously reported on 2006 report:								
001	D001	SOLVENT, NON HALOGENATED	59	P	BF	2175	P	BF
002	MN02	SEWERED LAB WASTE	75	P	SG	75	P	SG
003	D039	SOLVENT, HALOGENATED	0	P	IT	0		
~~004~~	~~MN02~~	~~CHEMICAL, FORMALDEHYDE~~	~~80~~	~~P~~	~~IT~~			
006	MN03	MINERAL OIL, PCB	0	P	IT	0		
007	D002	PAINT RELATED MATERIAL	1718	P	BF	2375	P	BF
011	D008	USED OIL, GREASE	0	G	RB	0		
012	D007	WOOD PRESERVATIVE	0	P	IT	0		
13	D006	HAZARDOUS WASTE SOLID, METAL	1575	P	MM	442	P	BF
014	D002	CORROSIVE LIQUID	537	P	MM	1180	P	mm
015	MN02	EXPIRED CHEMICALS, HAZARDOUS	23	P	MM	227	P	mm
016	D007	WATER, METAL CONTAMINATED	901	P	MM	60	P	mm

Part 2 - Waste Stream Information 2007 Continued

Please report: P = Pounds, G = Gallons, K = Kilograms

Inventory #	Waste Code (2- 0r 4-digit)	Name of Hazardous Waste	Amount Previously Reported		Mgmt Method	2007 Amount		
						Write in the amount and indicate pounds, gallons, or kilograms at the right.	*P, G, or K*	Mgmt Method
Wastes previously reported on 2006 report:								
018	D001	AEROSOLS	37	P	BF	19	P	BF
019	MN03	ELECTRICAL EQUIPMENT, PCB	446	P	LD	201	P	LD
023	MN01	CORROSIVE SOLIDS	0	P	SZ	0		
024	D001	OXIDIZER, LIQUID	0	P	SZ	0		
025	MN01	BORON TRIFLUORIDE	0	P	IT	0		
026	MN03	PCB Solids	0	P	LD	0		

Submitted: 2008

MINNESOTA EMERGENCY RESPONSE COMMISSION
444 CEDAR ST., SUITE 223, ST. PAUL, MN 55101
PHONE: (651) 297-7372 TTY (651) 282-6555
FAX (651) 296-0459

HAZARDOUS CHEMICAL REPORT

MINNESOTA COMMUNITY RIGHT-TO-KNOW
40 CFR PART 370 SUBPART B
(SECTION 311 REPORTING REQUIREMENT)

A Facility Identification

ERC ID#: 25--15--0001 SIC Code: 4911

Facility Name: Prairie Island Nuclear Generating Plant

Street Address: 1717 Wakonade Dr	Mailing Address: (If different from Street Address) 414 Nicollet Mall. (MP-8)
City, State, Zip Code: Redwing, MN	P.O. Box #:
County: Goodhue	City, State, Zip Code: Minneapolis, MN 55401
Primary Contact: Joan Neubauer	Alternate Contact: Jeanne Tobias
Telephone: 651--388--1121	Telephone: 651--388--1121

B Accompanying Information

40 CFR part 370.21 requires facilities to provide either material safety data sheets (MSDS's) or a list of chemical materials present at this facility in excess of the current "minimum threshold quantity" if you are required to prepare or maintain such MSDS's by OSHA.

1. Is this an initial submittal or an update? (Check one) ☐ Initial ☑ Update

2. Are you submitting MSDS's or a list? (Check one) ☐ MSDS ☑ List

3. Are any of these materials on the list of "Extremely Hazardous Substances" and present in excess of the "Threshold Planning Quantity" as defined in 40 CFR Part 355, published in the Federal Register April 22, 1987? (Check one) ☐ Yes ☑ No

4. Has a copy of the submittal been sent by you to your local fire department? (Check one) ☑ Yes ☐ No

5. What is the name and address of your local Fire Department?
Redwing Fire Dept. 420 Plum Street, Redwing, MN 55066

C Recommended List Format

Computer printouts or typed lists are also acceptable.

HAZARD CATEGORY (Check all that apply)					COLUMN I	COLUMN II
Immediate (acute) health	Delayed (chronic) health	Fire	Sudden Pressure Release	Reactivity	Chemical or Common Name	Hazardous Components as provided on the MSDS
✓	✓	✓			Molluscide CL-2005	CAS #64175

Continue list on back or additional forms

PS - 04000-03 (3/00)

Tier II Emergency and Hazardous Chemical Inventory

Reporting Period From January 1, 2007 to December 31, 2007

☑ Annual ☐ Revision

Facility Identification					
ID	3637				
Name	XCEL ENERGY - PRAIRIE ISLAND PLANT				
Street	1717 WAKONADE DRIVE	City	:	Red Wing	
County	Goodhue				
Fire Department	RED WING				
State	MN	Zip	:	55089	
Phone	612-337-2243	Lat/Long	:	44.622996/-92.641775	
Fax		Email	:	jayshree.b.desai@xcelenergy.com	

Owner/Operator Details					
Name	Xcel Energy				
Phone	612-337-2243				
Street Address	414 Nicollet Ave				
City	Minneapolis				
State	MN				
Zip	55402				
Country	United States				

Mailing Address if different from Facility ID Address					
Company	XCEL ENERGY - PRAIRIE ISLAND PLANT				
Attn	JAYSHREE DESAI				
Street Address 1	414 NICOLLET MALL (MP-8)				
Street Address 2					
City	MINNEAPOLIS	State	:	MN	
Zip	55401	Phone	:		
Country	United States				

Emergency Contacts					
Name	Joan Neubauer				
Title	Env Contact -NMC PI				
Phone	651-388-1121x4626	24 Hr.Phone	:	651-388-5577	
Name	Jeanne Tobias				
Title	Env Contact				
Phone	651-388-1121x4626	24 Hr.Phone	:	651-388-5577	

SIC Code	4911	Dun & Brad No	:		
NAICS		TRIFID	:		
EIN ID(Tax Number)		Client System Id	:	251500001	

Mixture Components are listed in the Appendix.

Certification: I certify under penalty of law that I have personally examined and am familiar with the information submitted, and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

Xcel Energy, Env. Analyst	1/31/2008 3:19:03 PM	
Name and official title of owner/operator or authorized representative	Date	Signature

Optional Attachments

- ☐ Site Plan
- ☒ Site Coordinate Abbreviations
- ☐ Other Safeguard measures
- ☐ Emergency Response Plan

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location
Chemical ID : 26562 Check if Chemical Information has changed from the last submission : ☐ CAS : N/A Trade Secret : ☐ Chemical Name : BLACK BEAUTY PRODUCTS EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☑ Solid ☐ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☒ Immediate ☐ Delayed (Chronic)	32000 Max Daily Amt(lbs) 04 Max Daily Amount Code 20000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type: J; Pressure: 1; Temperature: 4; Storage Location: PLANT
Chemical ID : 2615 Check if Chemical Information has changed from the last submission : ☐ CAS : 10043353 Trade Secret : ☐ Chemical Name : BORIC ACID EHS : ☐ Contains EHS : ☐ EHS Name : ☑ Pure ☑ Mix ☑ Solid ☑ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☒ Immediate ☒ Delayed (Chronic)	296340 Max Daily Amt(lbs) 05 Max Daily Amount Code 289340 Ave. Daily Amount (lbs.) 05 Ave. Daily Amount Code 365 No of days in site	Container Type: C; Pressure: 1; Temperature: 4; Storage Location: AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE
			Container Type: J; Pressure: 1; Temperature: 4; Storage Location: AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE
			Container Type: C; Pressure: 1; Temperature: 4; Storage Location: AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE
			Container Type: C; Pressure: 1; Temperature: 4; Storage Location: AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location
Chemical ID : 23728 Check if Chemical Information has changed from the last submission : ☐ CAS : 124389 Trade Secret : ☐ Chemical Name : CARBON DIOXIDE EHS : ☐ Contains EHS : ☐ EHS Name : ☑ Pure ☐ Mix ☐ Solid ☑ Liquid ☑ Gas	☐ Fire ☒ Pressure ☒ Reactivity ☐ Immediate ☐ Delayed (Chronic)	15000 Max Daily Amt(lbs) 04 Max Daily Amount Code 15000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type: L; Pressure: 2; Temperature: 4; Storage Location: TURBINE BLDG; GAS HOUSE-E SIDE OF PLANT Container Type: C; Pressure: 2; Temperature: 7; Storage Location: TURBINE BLDG; GAS HOUSE-E SIDE OF PLANT
Chemical ID : 26793 Check if Chemical Information has changed from the last submission : ☐ CAS : 7440440 Trade Secret : ☐ Chemical Name : COKE METALLERGICAL EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☑ Solid ☐ Liquid ☐ Gas	☐ Fire ☐ Pressure ☒ Reactivity ☐ Immediate ☐ Delayed (Chronic)	65000 Max Daily Amt(lbs) 04 Max Daily Amount Code 30000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 014 No of days in site	Container Type: R; Pressure: 1; Temperature: 4; Storage Location: PLANT WELLS

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location
Chemical ID : 2614 Check if Chemical Information has changed from the last submission : ☐ CAS : 68476346 Trade Secret : ☐ Chemical Name : DIESEL FUEL #2 EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☑ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☑ Delayed (Chronic)	2572065 Max Daily Amt(lbs) 06 Max Daily Amount Code 2225100 Ave. Daily Amount (lbs.) 06 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location B / 1 / 4 / TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC. C / 1 / 4 / TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC. A / 1 / 4 / TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC. C / 1 / 4 / TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC.
Chemical ID : 25208 Check if Chemical Information has changed from the last submission : ☐ CAS : 69011207 Trade Secret : ☐ Chemical Name : EPICOR ANION/CATION RESIN EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☑ Solid ☐ Liquid ☐ Gas	☑ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☑ Delayed (Chronic)	43000 Max Daily Amt(lbs) 04 Max Daily Amount Code 43000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location C / 1 / 4 / WAREHOUSE #2; VARIOUS AREAS IN PLANT E / 1 / 4 / WAREHOUSE #2; VARIOUS AREAS IN PLANT

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location
Chemical ID : 21246 Check if Chemical Information has changed from the last submission : ☐ CAS : 107211 Trade Secret : ☐ Chemical Name : ETHYLENE GLYCOL EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☑ Delayed (Chronic)	57434 Max Daily Amt(lbs) 04 Max Daily Amount Code 56000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location D / 1 / 4 / WAREHOUSE #3 - D5 & D6 BUILDING - COMPUTER ROOM CHILLER C / 1 / 4 / WAREHOUSE #3 - D5 & D6 BUILDING - COMPUTER ROOM CHILLER
Chemical ID : 2617 Check if Chemical Information has changed from the last submission : ☐ CAS : 302012 Trade Secret : ☐ Chemical Name : HYDRAZINE 35% EHS : ☑ Contains EHS : ☐ EHS Name : HYDRAZINE ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☐ Fire ☐ Pressure ☑ Reactivity ☑ Immediate ☑ Delayed (Chronic)	2300 Max Daily Amt(lbs) 03 Max Daily Amount Code 863 Ave. Daily Amount (lbs.) 02 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location E / 1 / 4 / WAREHOUSE #2; OUTSIDE COLD CHEMICAL LABORATORY E / 1 / 4 / WAREHOUSE #2; OUTSIDE COLD CHEMICAL LABORATORY
Chemical ID : 17419 Check if Chemical Information has changed from the last submission : ☐ CAS : 7439921 Trade Secret : ☐ Chemical Name : LEAD AND LEAD COMPOUNDS EHS : ☐ Contains EHS : ☐ EHS Name : ☑ Pure ☑ Mix ☑ Solid ☐ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☑ Delayed (Chronic)	46200 Max Daily Amt(lbs) 04 Max Daily Amount Code 46200 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location R / 1 / 4 / LEAD-ACID BATTERIES IN PLANT AND SUBSTATION
Chemical ID : 33325 Check if Chemical Information has changed from the last submission : ☐ CAS : 64175 Trade Secret : ☐ Chemical Name : MOLLUSCIDE CL-2005 EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☑ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☑ Delayed (Chronic)	28000 Max Daily Amt(lbs) 04 Max Daily Amount Code 0 Ave. Daily Amount (lbs.) 01 Ave. Daily Amount Code 30 No of days in site	Container Type / Pressure / Temperature / Storage Location O / 1 / 4 / PLANT YARD AREA.

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location
Chemical ID : 18171 Check if Chemical Information has changed from the last submission : ☐ CAS : 7647156 Trade Secret : ☐ Chemical Name : NALCO 1318 LIQUID EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☒ Immediate ☐ Delayed (Chronic)	15530 Max Daily Amt(lbs) 04 Max Daily Amount Code 0 Ave. Daily Amount (lbs.) 01 Ave. Daily Amount Code 365 No of days in site	Container Type: C; Pressure: 1; Temperature: 4; Storage Location: CHLORINE HOUSE
Chemical ID : 12828 Check if Chemical Information has changed from the last submission : ☐ CAS : 7727379 Trade Secret : ☐ Chemical Name : NITROGEN, REFRIGERATED LIQUID EHS : ☐ Contains EHS : ☐ EHS Name : ☑ Pure ☐ Mix ☐ Solid ☑ Liquid ☑ Gas	☐ Fire ☒ Pressure ☐ Reactivity ☒ Immediate ☐ Delayed (Chronic)	22831 Max Daily Amt(lbs) 04 Max Daily Amount Code 22831 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type: L; Pressure: 2; Temperature: 4; Storage Location: EAST OF TURBINE BLDG Container Type: A; Pressure: 2; Temperature: 7; Storage Location: EAST OF TURBINE BLDG

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location

Chemical ID : 17994
Check if Chemical Information has changed from the last submission : ☐
CAS : 7439921
Trade Secret : ☐
Chemical Name : OIL, LUBE
EHS : ☐ **Contains EHS** : ☐
EHS Name :
☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas

Physical & Health Hazards
☑ Fire
☐ Pressure
☐ Reactivity
☐ Immediate
☐ Delayed (Chronic)

Inventory
474975 Max Daily Amt(lbs)
05 Max Daily Amount Code
385350 Ave. Daily Amount (lbs.)
05 Ave. Daily Amount Code
365 No of days in site

Storage Codes & Location

Container Type	Pressure	Temperature	Storage Location
A	1	4	OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE
C	1	4	OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE
D	1	4	OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE
R	1	4	OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE

Chemical ID : 20104
Check if Chemical Information has changed from the last submission : ☐
CAS : 74986
Trade Secret : ☐
Chemical Name : PROPANE (LIQUIFIED PETROLEUM GAS)
EHS : ☐ **Contains EHS** : ☐
EHS Name :
☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☑ Gas

Physical & Health Hazards
☑ Fire
☑ Pressure
☐ Reactivity
☑ Immediate
☐ Delayed (Chronic)

Inventory
12600 Max Daily Amt(lbs)
04 Max Daily Amount Code
11130 Ave. Daily Amount (lbs.)
04 Ave. Daily Amount Code
365 No of days in site

Storage Codes & Location

Container Type	Pressure	Temperature	Storage Location
A	1	4	WEST SIDE OF PLANT
A	1	4	WEST SIDE OF PLANT
A	1	4	WEST SIDE OF PLANT
A	1	4	WEST SIDE OF PLANT

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location
Chemical ID : 2616 Check if Chemical Information has changed from the last submission : ☐ CAS : 1310732 Trade Secret : ☐ Chemical Name : SODIUM HYDROXIDE 50% EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☑ Delayed (Chronic)	45822 Max Daily Amt(lbs) 04 Max Daily Amount Code 44000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location C / 1 / 4 / INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES C / 1 / 4 / INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES C / 1 / 4 / INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES D / 1 / 4 / INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES
Chemical ID : 18234 Check if Chemical Information has changed from the last submission : ☐ CAS : 7681529 Trade Secret : ☐ Chemical Name : SODIUM HYPOCHLORITE SOLUTION EHS : ☐ Contains EHS : ☐ EHS Name : ☐ Pure ☑ Mix ☐ Solid ☑ Liquid ☐ Gas	☐ Fire ☐ Pressure ☐ Reactivity ☑ Immediate ☐ Delayed (Chronic)	25460 Max Daily Amt(lbs) 04 Max Daily Amount Code 12000 Ave. Daily Amount (lbs.) 04 Ave. Daily Amount Code 365 No of days in site	Container Type / Pressure / Temperature / Storage Location C / 1 / 4 / CHLORINE BUILDING C / 1 / 4 / CHLORINE BUILDING

Chemical Description	Physical & Health Hazards	Inventory	Storage Codes & Location

Chemical ID : 2613
Check if Chemical Information has changed from the last submission : ☐
CAS : 7664939
Trade Secret : ☐
Chemical Name : SULFURIC ACID
EHS : ☑ Contains EHS : ☐
EHS Name : SULFURIC ACID
☑ Pure ☐ Mix ☐ Solid ☑ Liquid ☐ Gas

Physical & Health Hazards:
☐ Fire
☐ Pressure
☐ Reactivity
☑ Immediate
☑ Delayed (Chronic)

Inventory:

4360	Max Daily Amt(lbs)
03	Max Daily Amount Code
4360	Ave. Daily Amount (lbs.)
03	Ave. Daily Amount Code
365	No of days in site

Storage Codes & Location:

Container Type	Pressure	Temperature	Storage Location
C	1	4	E SIDE OF PLANT; CHEMICAL STOREROOM; CHEMICAL LABS; LEAD ACID BATTERIES
M	1	4	E SIDE OF PLANT; CHEMICAL STOREROOM; CHEMICAL LABS; LEAD ACID BATTERIES
R	1	4	E SIDE OF PLANT; CHEMICAL STOREROOM; CHEMICAL LABS; LEAD ACID BATTERIES

1/14/08 done

10/21/2007

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY WORKSHEET

EPA Reporting Year: 2007

Plant: ***Prairie Island Generating Plant*** JOAN Newhauser ← *Contact Person:* *Jeanne Tobias* *Work Phone:* *(651) 388-1121*

ERC ID#: *25-150-0001* *Alternate Contact:* ↗

24 hr #: *(651) 388-5577*

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Year	Maximum Amount On-Site	Average Amount On-Site	Reportable for 2007?
Acetone	561		Warehouse #3,	Drums	55 Gallons	2007 2006	110 165	110 110	
~~Acetone~~	~~3670~~		695 Truck Aisle, No EHS	Drums	55 Gallons	2007 2006	 55	 55	
Alcohol Milsolve	562		Warehouse #3	Barrels	55 Gallons	2007 2006	 55	 55	
Alcohol Milsolve	3671		695 Truck Aisle	Drums	55 Gallons	2007 2006	 110	 55	
Alumina Dessicant	2522		Warehouse #1. For air dryer	Drums	55 Gallons	2007 2006	 110	 110	
Ammonium Hydroxide (28%)	1717		Outside Cold Lab. Not an EHS. Liquid is 7.5 lb/gal. Approx. 28% -30% NH3.	~~Drums~~ Pails	5 Liters	2007 2006	150 10	150 5	
Batteries -Lead & Lead Compounds in Lead-Acid	2065		Various areas (warehouse #2 and #8, Turbine and Service Bldg., battery room etc.) Approx. 10.6 lb of Pb/ lb of acid. 10.6 x 4360 lb of acid = 46,200	Battery	Lbs	2007 2006	 46,200	 46,200	
Batteries, Sulfuric Acid in Lead Acid Batteries	1744		Various areas (warehouse #2 and #8, Turbine and Service Bldg., battery room etc.) Total = approx. 4360 lb of sulfuric acid.	Battery	Lbs	2007 2006	 4360	 4360	
Black Beauty Slag Products	2279		~~Warehouse #3. Slag used for sand blasting.~~ Outside paint shop - south side	Bags	50 Lbs	2007 2006	 32,000	 20,000	
Boric Acid (0 - 2%)	553		Reactor coolant system	Flow Through Process Tank	14000 Lbs	2007 2006	 14,000	 7,000	
Boric Acid (0 - 2%) Solid	550		Above Laundry area - 755' level, ~~Decon~~ Warehouse #2 and #3	Bags	50 Lbs	2007 2006	 38,000	 38,000	
Boric Acid (12%)	554		735' auxiliary bldg (121 boric acid batching tank)	Flow Through Process Tank	800 Gallons	2007 2006	 800	 800	
Boric Acid (12%)	940		735' auxiliary building (11 boric acid storage tank)	Flow Through Process Tank	5000 Gallons	2007 2006	 5000	 5000	
Boric Acid (12%)	941		735' auxiliary building (121 boric acid storage tank) density =12.3 lb/gal	Flow Through Process Tank	5000 Gallons	2007 2006	 5000	 5000	

Boric Acid (12%)	942		735' auxiliary building (21 boric acid storage tank)	Flow Through Process Tank	5000 Gallons	2007 2006		5000	
Boric Acid (6%)	552		Spent fuel pool and refueling storage tank	Other	50000 Lbs	2007 2006		50000	
Brine, R. O.	1965		Indoor, West of water treatment (flow trough process tank). No EHS. Assumed water density 8.4 lb/gal. Brine concentration in R. O. water 26%	AST	10000 Gallons	2007 2006		10,000	
Carbon Dioxide, Gas	1053		GAS House	Cylinders	60 Lbs	2007 2006		3000	
Carbon Dioxide, Liquid	1052		Turbine bldg	Tank	12000 Lbs	2007 2006		12,000	
Coke, Metallurgical	2369		Bone Yard. Used in turbine bldg sumps to absorb oil. (Note: inventory should include installed coke + amt on-site in drums + amt on-site awaiting	Drums	Lbs	2007 2006		30,000	
Diesel Fuel	2015		Tank farm, north of plant near #5 warehouse.	AST	550 Gallons	2007 2006		250	
Diesel Fuel #2	194	194	~~Inside guard house.~~ (day tank for security diesel) Building East of guard house	AST	500 Gallons	2007 2006		500	
Diesel Fuel #2	195	195	Plant screenhouse (#12 diesel cooling water pump day tank)	AST	580 Gallons	2007 2006		575	
Diesel Fuel #2	196	196	Plant screenhouse (# 22 diesel cooling water pump day tank)	AST	580 Gallons	2007 2006		575	
Diesel Fuel #2	197	197	~~D2~~ Turbine Bldg. ~~Day Tank~~ D1 diesel Generator fuel oil day tank Turbine Bldg.	AST	500 Gallons	2007 2006		500	
Diesel Fuel #2	198	198	~~Inside turbine bldg.~~ (D2 diesel generator fuel oil day tank) ~~D2 Turbine Bldg. Day Tank~~	AST	500 Gallons	2007 2006		500	
Diesel Fuel #2	199	199	Plant screenhouse (fire pump diesel oil day tank)	AST	280 Gallons	2007 2006		200	
Diesel Fuel #2	200	200	D3 Diesel Generator Day Tank	AST	125 Gallons	2007 2006		100	
Diesel Fuel #2	201	201	D4 Diesel Generator Day Tank	AST	125 Gallons	2007 2006		100	
Diesel Fuel #2	210	210	D5/D6 Fuel Oil Receipt Tank, outside near SBO Bldg.	AST	15000 Gallons	2007 2006		1000	
Diesel Fuel #2	211	211	D5/D6 Fuel Oil Storage Tank -~~Underground Vault~~ VAULT	AST	32778 Gallons	2007 2006		32700	
Diesel Fuel #2	212	212	D5/D6 22 Fuel Oil Storage Tank -~~Underground~~ Vault	AST	32778 Gallons	2007 2006		32700	
Diesel Fuel #2	213	213	D5/D6 23 Fuel Oil Storage Tank-~~Underground~~ Vault	AST	32778 Gallons	2007 2006		32700	

Diesel Fuel #2	214	214	D5/D6 24 Fuel Oil Storage Tank ~~Underground~~ Vault	AST	32778 Gallons	2007 2006		32778	
Diesel Fuel #2	218	218	SBO Bldg. 21 Day Tank for D5 Diesel Generator	AST	665 Gallons	2007 2006		665	
Diesel Fuel #2	219	219	SBO Bldg. 22 Day Tank for D6 Diesel Generator	AST	665 Gallons	2007 2006		665	
Diesel Fuel #2	459	121	Plant Screenhouse (diesel fire pump oil storage tank) North of Heated Hazwaste Bldg.	UST	4000 Gallons	2007 2006		4000	
Diesel Fuel #2	460	124	~~South of service building~~ (124 diesel generator oil storage tank) North of Heated Hazwaste Bldg.	UST	19500 Gallons	2007 2006		19500	
Diesel Fuel #2	461	123	~~South of service building~~ (123 diesel generator oil storage tank) North of Heated Hazwaste Bldg.	UST	19500 Gallons	2007 2006		19500	
Diesel Fuel #2	462	122	~~South of service building~~ (122 diesel generator oil storage tank) North of Heated Hazwaste Bldg.	UST	19500 Gallons	2007 2006		19500	
Diesel Fuel #2	463	121	~~South of service building~~ (121 diesel generator oil storage tank) East	UST	19500 Gallons	2007 2006		19500	
Diesel Fuel #2	464	122	~~South~~ of turbine building (122 heating boiler oil storage tank) East	UST	35000 Gallons	2007 2006		35000	
Diesel Fuel #2	465	121	~~South~~ of turbine bldg. (121 heating boiler oil storage tank)	UST	35000 Gallons	2007 2006		35000	
Diesel Fuel #2	466	122	East of Plant Screenhouse (22 diesel cooling water pump oil storage tank)	UST	19500 Gallons	2007 2006		19500	
Diesel Fuel #2	467	121	East of Plant Screenhouse (12 diesel cooling water pump oil storage tank)	UST	19500 Gallons	2007 2006		19500	
Ethylene Glycol (100%)	592		Warehouse #3. Not an EHS. 9.4 lb/gal	Drums	55 Gallons	2007 2006	110 850	110 550	
Ethylene Glycol (50%) without Propylene	593		D5 & D6 ~~building systems~~, Not an EHS.	Other	5000 Gallons	2007 2006		4800	
Ethylene Glycol (50%)	594		~~3 Heating systems~~ and computer room chiller ~~Propylene~~ Aux bldg, Turb. Bldg., Admin Heating.	Other 3500	~~4600~~ Gallons	2007 2006	1200 ~~3000~~	1000 1400	
Formaldehyde various grades (5%, 10% & 37%)	1740		Formaldehyde various grades at PI environmental Laboratory	Pails	5 Gallons	2007 2006		11	
~~Freon 11~~ Not Propylene	1048		~~Not an EHS. NOT REPORTABLE in 2007~~ Delete.	~~Drums~~	~~200~~ Lbs	~~2007~~ 0 2006		200	
Freon 113	3672		Warehouse #3, No EHS,	Pails	~~30~~ 15 Gallons	2007 2006	90 30	60 30	
Freon 22	1050		Warehouse #3, (no EHSs) (9.9 lb/gal)	Cylinders	20 Lbs	2007 2006	20 100	20 100	

~~Copy~~ Source & Pool Floors.

Gasoline	2014	2014	Tank farm north of plant, near #5 Warehouse. ~~Installed July '00. Replaced tank #208.~~	AST	550 Gallons	2007 2006	 500	 250	
Halon 1301	1046		Various fire suppression areas; various sizes	Cylinders	 Lbs	2007 2006	 3731	 3731	
Hydrazine (1-5%)	3676		Chem Feed U1 and U2 Process piping 175 gallons each, EHS yes, 8.5 lb/gal	Piping	175 Gallons	2007 2006	 350	 350	
~~Hydrazine (35%)~~	~~557~~		~~Decon~~ Warehouse #2 Duplicate to #3675	~~Drums~~ Delete.	~~30~~ Gallons	~~2007~~ 2006	 300	 200	
Hydrazine (35%)	558	3	Outside cold lab. EHS. Liquid = 8.5 lb/gal, Unit 1 Turbine Bldg. 695'	Drums	30 Gallons	2007 2006	 120	 60	
Hydrazine 35% ~~Scavex~~ Scavox	3675		~~Decon~~ Warehouse, ~~EHS~~, 8.5 lb/gal #2	Drums	30 Gallons	2007 2006	270 6600	180 3300	
~~Hydrochloric Acid~~	837		Chem Storage Room, cold lab 695'; hot lab (exempt) ~~ask~~ Delete	~~Glass Bottles~~	~~0.5~~ Gallons	~~2007~~ 2006	 4	 2	
Hydrogen Gas	1054		Hydrogen gas house (1 lb / 194 ft3)	Cylinders	261 Cubic Feet	2007 2006	 13050	 13050	
Isothiazolin, GE Betz Spectrus 1106	1962		Chem Storage Room, no EHS, 11.62 lb/gal.	Pails	5 Gallons	2007 2006	 5	 5	
Kerosene	781		Warehouse #3, 6.9 lb/gal. Not an EHS.	Pails	5 Gallons	2007 2006	0 50	0 40	
Kerosene	1718		Warehouse #3, 6.9 lb/gal. Not an EHS.	Drums	55 Gallons	2007 2006	 220	 110	
Molluscide CL-2005, Chemtreat, ZM Molluscide	3685		This product was to the site for 3 days in 4 drums and 4 totes. ax	Drums	55 Gallons	2007 2006	0 220	0 0	
Molluscide CL-2005, Chemtreat, ZM Molluscide	3702		This product was at the site for 3 days in 4 drums and 4 totes.	Tote Tank	400 Gallons	2007 2006	3200 1600	0 0	ok
Molybdate Corrosion Inhibitor,GE Betz MD 4106	2914		Unit 2 Turbine Bldg. 715", ~~Decon~~ Warehouse #3 by 2X system Storage area outside	Drums	55 Gallons	2007 2006	165 385	110 385	
Nalco 1250, Carbohydrazide	1251		Cold Lab 695'. No EHSs. 8.7 lb/gal.	~~Barrels~~ DRUMS	55 Gallons	2007 2006	55 110	 55	
Nalco 1318, Sodium Bromide	967	121	Inside chlorine building. 12.2 lb/gal. NaBr = 40%. No EHSs.	AST	1273 Gallons	2007 2006	 1273	0 500	
Nalco 1336 (Sodium Tolyltriazol)	2915		Chem Storage Room.	Pails	5 Gallons	2007 2006	 10	 5	
Nalco 39M Corrosion Inhibitor, Nitrite Based	1433		Chem Storage Room, No EHSs present. 9.5 lb/gal.	Pails	5 Gallons	2007 2006	5 55	5 30	
Nalco 39M Corrossion Inhibitor, Nitrite Based	3677		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006	 55	 55	

Nalco 7338 (Biocide)	833		Chem Storage Room, No EHSs (9.3 lb/gal)	Pails	5 Gallons	2007 2006	5 10	5 10	
Nalco 8103 Coagulant	2917		Chem Storage Room, No EHS, 9.1 lbs/gal	Pails	5 Gallons	2007 2006	 10	 5	
Nalco 8320 (300 ppm Sodium Chromate)	2016		This tank is actualy a "holding" tank for when maintenance is performed on the emergency diesel. No EHSs present. Approx. 8.3 lb/gal This	AST	500 Gallons	2007 2006	 500	 150	
Nalco 8320, Sodium Chromate	910		~~Decon~~ Warehouse, Pure prodct. No EHSs. 14.2 lb/gal.	Drums	30 Gallons	2007 2006	 30	 30	
Nalco 8338 (Nitrite Based corrosion Inhibitor)	2916		Chem Storage Room,	Pails	5 Gallons	2007 2006	10 15	10 15	
~~Nalco Glutablohyde, GE~~ Betz Spectrus NX 1105	2156		Chemi~~cal~~ Storage Room, Not EHS	Pails	5 Gallons	2007 2006	5 10	 5	
Nalco Pre-tect 2040 HP (MPA)	1044		~~Decon~~ Warehouse, No EHSs present. 8.1 lb/gal.	Drums	55 Gallons	2007 2006	220 4050	165 2035	
Nalco Pre-tect 2040 HP (MPA)	3673		~~Outside~~ Chem Feed ~~Stations~~ Fume Hoods Both Units	Drums	55 Gallons	2007 2006	 110	 110	
Nalco Pre-tect 2040 HP (MPA)	3674		Cold Lab Chemical Area, No EHS ~~Outside~~.	Drums	55 Gallons	2007 2006	 110	 110	
Nitrogen, Liquid	555		East of turbine building	Tank	1500 Gallons	2007 2006	 1500	 1500	
Nitrogen, Liquid	556		East of turbine building	Tank	1500 Gallons	2007 2006	 1500	 1500	
Oil Mobil SHC 525	3689		Warehouse #3	Drums	55 Gallons	2007 2006	330 55	330 55	
Oil Mobil, Voetra Oil #2	3684		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006	 55	 55	
Oil SAE 15W-40W Soot Control	3682		Warehouse #3	Drums	55 Gallons	2007 2006	1265 2035	1265 2035	
Oil, Caltran Transformer	3680		Warehouse #3	Drums	55 Gallons	2007 2006	0 55	0 55	
Oil, Delvac 1330	3683		Warehouse #3	Drums	55 Gallons	2007 2006	0 100	0 55	
Oil, Delvac 1630	2967		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	 100	 55	
Oil, Diesel Lube	572		Plant Screenhouse (#12 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	2007 2006	 110	 100	
Oil, Diesel Lube	573		Plant Screenhouse (#22 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	2007 2006	 110	 100	

Oil, Diesel Lube	576		Turbine building (D1 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	2007 2006	[redacted] 250	[redacted] 150	[redacted]
Oil, Diesel Lube	577		Turbine building (D2 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	2007 2006	[redacted] 250	[redacted] 150	[redacted]
Oil, Diesel Lube	579		D3 building ~~south of reactor~~ (D3 diesel generator crankcase) Eastof Turbine Bldg.	Flow Through Process Tank	250 Gallons	2007 2006	[redacted] 250	[redacted] 150	[redacted]
Oil, Diesel Lube	580		D4 building ~~south of reactor~~ (D4 diesel generator crankcase) Eastof turbine Bld.	Flow Through Process Tank	250 Gallons	2007 2006	[redacted] 250	[redacted] 150	[redacted]
Oil, DTE 24	2966		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE 25	2968		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE 25	3701		Warehouse #3	Drums	55 Gallons	2007 2006	[redacted] 55	[redacted] 55	[redacted]
Oil, DTE Oil BB SAE 40	2957		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE Oil BB SAE 40	3694		Warehouse #3	Drums	55 Gallons	2007 2006	[redacted] 330	[redacted] 330	[redacted]
Oil, DTE Oil Extra Heavy SAE 30	2960		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE Oil Extra Heavy SAE 30	3695		Warehouse #3	Drums	55 Gallons	2007 2006	[redacted] 495	[redacted] 495	[redacted]
Oil, DTE Oil Heavy	2961		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE Oil Heavy	3696		Warehouse #3	Drums	55 Gallons	2007 2006	[redacted] 330	[redacted] 330	[redacted]
Oil, DTE Oil Heavy Medium SAE 20	3697		Warehouse #3	Drums	55 Gallons	2007 2006	[redacted] 165	[redacted] 165	[redacted]
Oil, DTE Oil Heavy Medium SAE 20	3698		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006	[redacted] 55	[redacted] 55	[redacted]
Oil, DTE Oil Heavy Medium SAE 20	3699		Oil Room in Turbine Bldg.	Tank	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE Oil Light SAE 10	3700		Warehouse #3	Drums	55 Gallons	2007 2006	[redacted] 275	[redacted] 275	[redacted]
Oil, DTE Oil Medium	2963		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]
Oil, DTE Oil, SAE10	2964		Oil Room in Turbine Unit1 Bldg.	AST	100 Gallons	2007 2006	[redacted] 100	[redacted] 55	[redacted]

Oil, Duragard Super HD 15W-40	2956		Oil Room in Turbine Bldg	AST	100 Gallons	2007 2006		100 55	
Oil, EHC	3681		Warehouse #3, No EHS	Drums	55 Gallons	2007 2006	110 275	110 275	
Oil, Fryquel EHC Hydraulic Fluid	1336		Oil Room in Turbine Bldg. Not an EHS. (9.5 lb/gal)	Drums	55 Gallons	2007 2006	55 110	55 55	
Oil, Gargoyle, SHC 224	3678		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006		 55	
Oil, Lube	220		SBO Building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	2007 2006		 800	
Oil, Lube	221	22	SBO Building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	2007 2006		 800	
Oil, ~~Make Up~~ Turbine Lube Oil 1-2 Storage Tank	584	584	Oil Room in Turbine Bldg.	AST	14000 Gallons	2007 2006		 10000	
Oil, Mobil 450 NC	3686		warehouse #3	Drums	55 Gallons	2007 2006		880 1265	
Oil, Mobil 450 NC	3687		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006		 55	
Oil, Mobil Gard 629	2958		Oil Room in Turbine Bldg. ~~Unit 1 695'~~	AST	100 Gallons	2007 2006		 55	
Oil, Mobil Gard 629	3690		Warehouse #3	Drums	55 Gallons	2007 2006	0 440	0 440	
Oil, Mobil Rarus 827	2965		Oil Room in Turbine Bldg. ~~695'~~ Oil is filtered	AST	100 Gallons	2007 2006		 55	
Oil, Mobil SHC 525	3688		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006		 55	
Oil, Mobil SHC 630	1746		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006		 55	
Oil, Mobil SHC 630	3691		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006		 55	
Oil, Mobil SHC 824	3692		Warehouse #3	Drums	55 Gallons	2007 2006		990 1045	
Oil, Mobil -SHC 824	3693		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006		 55	
Oil, Mobil SHC-525	2970		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006		 55	
Oil, Mobil SHC-632	2969		Oil Room in Turbine Bldg.	AST	100 Gallons	2007 2006		 55	

Oil, Mobile SHC 630	2955		Oil Room in Turbine ~~Bldg.~~ Bldg. ~~Oil is filtered~~.	AST	100 Gallons	2007 2006		100	55
Oil, Mobilgard 450 NC	2959		Oil Room Turbine Bldg.	AST	100 Gallons	2007 2006	100 ~~55~~		55
Oil, Turbine Lube makeup tank	585	585	Oil Room in Turbine Bldg.	AST	2000 Gallons	2007 2006		2000	1500
Oil, Turbine Lube	586	11	Turbine building (#1 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	2007 2006		14000	13000
Oil, Turbine Lube	587	21	Turbine building (#2 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	2007 2006		14000	13000
Oil, Used	202	202	Outside west of plant (Used Oil Tank).	AST	5000 Gallons	2007 2006	1000	3500	1000 1500
Oil, Used	203	203	Outside west of plant (Used Oil Tank).	AST	5000 Gallons	2007 2006	1000	3500	1000 1500
Oil, Used	217	217	Oil Room Turbine Bldg.	AST	250 Gallons	2007 2006		250	150
Oil, Whiterex 425	3679		Oil Room in Turbine Bldg.	Drums	55 Gallons	2007 2006		55	55
Oxygen, Liquid	1056		Turbine bldg	Dewars	25 Gallons	2007 2006		50	35
Propane	588		West of plant	Tank	1000 Gallons	2007 2006		900	800
Propane	589		West of plant. Used for NPD heat. No EHSs present. 4.2 lb/gal.	Tank	1000 Gallons	2007 2006		900	800
Propane	590		West of plant, Used for NPD Bldg. heat.	Tank	1000 Gallons	2007 2006		900	800
Propane	1657		Met tower bldg	Tank	250 Gallons	2007 2006		250	250
Resin, Amberlite IRN-217, ~~Rhom~~ Rohm and Haas	3703		~~Decon~~ Warehouse ~~(Lithium Hydroxide)~~ #2 1'1x5'3	Pails	~~139~~ 177 ~~Lbs~~	2007 2006	585 gal ~~53~~ 71 165		585 gal 36
Resin, Clinophthilonite, Fisher	3706		~~Decon~~ Warehouse ~~#2~~	Pails	7 Cubic Feet	2007 2006		21	21
Resin, PD-11-NH4, Epicon	3704		~~Decon~~ Warehouse (~~FILTER-DEMIN-RESIN~~) ~~#2~~	Pails	~~28~~ 165 ~~Cubic Feet~~	2007 2006	700 lbs	40	700 lbs 40
Resins, Demineralizer	1327		Various Locations (installed and in stock). Includes: Epicor anion, cation and mixed bed resins. No EHSs. 10.0 lb/gal	Fiber Drums & Flow Thru Process Tanks	Lbs	2007 2006		37000	37000
Resins, PD-32-NH4, Epicor	3705		~~Decon~~ Warehouse (~~FILTER-DEMIN-RESIN~~) #2	Pails	~~28~~ 125 ~~Cubic Feet~~	2007 2006	728 lbs 100		728 lbs 100

4379 ?

Salt (Sodium Chloride)	2296		Training center and various plant areas and turbine bldg. No EHSs present.	Bags	50 Lbs	2007 2006	[redacted] 2000	[redacted] 2000	[redacted]
Sodium Bisulfate	1743		~~Decon~~ Warehouse, ~~Not an EHS Water Treatment Cleaning~~ #2	Drums	100 Lbs	2007 2006	[redacted] 100	[redacted] 100	[redacted]
Sodium Carbonate	1742		~~Decon~~ Warehouse #2	Pails	50 Lbs	2007 2006	[redacted] 50	[redacted] 50	[redacted]
Sodium Hydroxide (10%)	206	11	Inside auxiliary bldg (caustic standpipe - unit 1). Not an EHS. Approx. 8.3 lb/gal.	AST	2700 Gallons	2007 2006	[redacted] 2700	[redacted] 2600	[redacted]
Sodium Hydroxide (10%)	207	21	Inside auxiliary bldg (caustic standpipe - unit 2)	AST	2700 Gallons	2007 2006	[redacted] 2700	[redacted] 2600	[redacted]
Sodium Hydroxide (10%)	2274		~~Decon~~ Warehouse. ~~Received on 4/06.~~ #2	Drums	55 Gallons	2007 2006	[redacted] 55	[redacted] 55	[redacted]
Sodium Hypochlorite (15%)	215	121	Inside chlorine bldg (bulk sodium hypochlorite tank) No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	2007 2006	[redacted] 1273	[redacted] 600	[redacted]
Sodium Hypochlorite (15%)	966	122	Inside chlorine building (bulk sodium hypochlorite tank). No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	2007 2006	[redacted] 1273	[redacted] 600	[redacted]
Sodium Sulfite	1332		Outside Cold Lab. Not EHS or TRI. 21.6 lb/gal. Bleach used for spill clean-up.	~~Bags~~ Pails	100 Lbs	2007 2006	[redacted] ~~400~~	[redacted] 100	[redacted]
Stoddard Solvent	563		Warehouse #3, 595' level, truck isle. No EHS. 6.5 lb/gal	Barrels	55 Gallons	2007 2006	[redacted] 275	[redacted] 165	[redacted]
Sulfur Hexaflouride	841		Substation bldg. Several small cylinders. Not an EHS.	Cylinders	480 Lbs	2007 2006	[redacted] 480	[redacted] 360	[redacted]
Zep Dyna 143	1655		Warehouse #3 and in two parts washers. ~~Installed late in 1999~~. 6.5 lb/gal. No EHSs.	~~Drums~~	~~30~~ 20 Gallons	2007 2006	[redacted] ~~220~~	[redacted] 110	[redacted]
Additional Substance (list):			See attachment			2007			
Additional Substance (list):						2007			

This inventory check will be done periodically, so keep a copy for future reference. Thank you for your help in EPCRA Section 312 compliance.

To the best of my knowledge, the information on this form is correct:

Signed: [redacted] Date: 1-10-08

	New Items					2007 Inventory		
No.	Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container	Maximum Amount	Average Amount
1	Acetylene Gas			Outside Hydrogen gas house	Cylinders	40 lbs	160 lbs	160 lbs
2	Nitrogen Gas			Gas House	Cylinders	60 lbs	3000 Lbs.	3000 Lbs.
3	Propane Gas			Outside Hydrogen gas house and various locations	Cylinders	50 lbs	100 lbs	100 lbs
4	Fleet Charge Antifreeze			Oil Room Turbine Bldg.	Drums	55 gal	55 gal	55 gal
5	600 Cutting Fluid			Oil Room Turbine Bldg.	Drums	55 gal	55 gal	55 gal
6	Waste Oil			Oil Room Turbine Bldg.	Drums	55 gal	55 gal	55 gal
7	Oil, Duragard Super HD 15W-40			Oil Room Turbine Bldg.	Drums	55 gal	55 gal	55 gal
8	Fleet Charge			715' NE Corner of Turbine Building	Drums	55 gal	110 gal	55 gal
9	Sodium Bisulfate			Chem Storage Room	Pails	5 gal	10 gal	5 gal
10	Ice Melt			Various locations in and outside plant	Bags	50 Lbs.	2500 lbs	2500 lbs.
11	SAC H resin			Storage Area by cold lab.	Pails	5 cu. Ft.	5 cu. Ft	5 cu. Ft.
12	Nalco 1250			Warehouse #2	Drums	55 gal	110 gal	110 gal
13	Nalco 39M			Warehouse #2	Drums	46.3 lb	92.6 lb	92.6 lb
14	Spectrus NX1105			Warehouse #2	Pails	43 lb	86 lb	86 lb
15	Spectrus NX 1106			Warehouse #2	Pails	42 lb	84 lb	84 lb
16	Nalco 8322			Warehouse #2	Drums	55 gal	165 gal	165 gal
17	Sodium Hydroxide (50%)			Warehouse #2	Drums	187 lb	374 lb	374 lb
18	Sonotrace			Warehouse #1.	Drums	55 gal	55 gal	55 gal
19	Alumina Dessicant			Warehouse #1	Drums	30 gal	120 gal	120 gal
20	Alumina Dessicant			Warehouse #1	Drums	20 gal	60 gal	60 gal

	New Items			
No.	Substance	Xcel Record #	Site Tank #	Storage Location
1	Acetylene Gas			Outside Hydrogen gas house
2	Nitrogen Gas			Gas House
3	Propane Gas			Outside Hydrogen gas house and variou
4	Fleet Charge Antifreeze			Oil Room Turbine Bldg.
5	600 Cutting Fluid			Oil Room Turbine Bldg.
6	Waste Oil			Oil Room Turbine Bldg.
7	Oil, Duragard Super HD 15W-40			Oil Room Turbine Bldg.
8	Fleet Charge			715' NE Corner of Turbine Building
9	Sodium Bisulfate			Chem Storage Room
10	Ice Melt			Various locations in and outside plant
11	SAC H resin			Storage Area by cold lab.
12	Nalco 1250			Warehouse #2
13	Nalco 39M			Warehouse #2
14	Spectrus NX1105			Warehouse #2
15	Spectrus NX 1106			Warehouse #2
16	Nalco 8322			Warehouse #2
17	Sodium Hydroxide (50%)			Warehouse #2
18	Sonotrace			Warehouse #1.
19	Alumina Dessicant			Warehouse #1
20	Alumina Dessicant			Warehouse #1

Storage Method	2007 Inventory		
	Container	Maximum Amount	Average Amount
Cylinders	40 lbs	160 lbs	160 lbs
Cylinders	60 lbs	3000 Lbs.	3000 Lbs.
Cylinders	50 lbs	100 lbs	100 lbs
Drums	55 gal	55 gal	55 gal
Drums	55 gal	55 gal	55 gal
Drums	55 gal	55 gal	55 gal
Drums	55 gal	55 gal	55 gal
Drums	55 gal	110 gal	55 gal
Pails	5 gal	10 gal	5 gal
Bags	50 Lbs.	2500 lbs	2500 lbs.
Pails	5 cu. Ft.	5 cu. Ft	5 cu. Ft.
Drums	55 gal	110 gal	110 gal
Drums	46.3 lb	92.6 lb	92.6 lb
Pails	43 lb	86 lb	86 lb
Pails	42 lb	84 lb	84 lb
Drums	55 gal	165 gal	165 gal
Drums	187 lb	374 lb	374 lb
Drums	55 gal	55 gal	55 gal
Drums	30 gal	120 gal	120 gal
Drums	20 gal	60 gal	60 gal

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***	*Contact Person:* *Joan Neubauer*	*Work Phone:* *(651) 388-1121*
	Alternate Contact: *Jeanne Tobias*	*Work Phone:* *(651) 388-1121*
ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
600 Cutting Fluid	1450		Oil Room Turbine Bldg.,9.7 lbs/gal, no EHS	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Acetone	561		Warehouse #3,	Drums	55 Gallons	110 Gallons	110 Gallons	No
Acetone	3670		695 Truck Aisle, No EHS	Drums	55 Gallons	55 Gallons	55 Gallons	No
Acetylene Gas	3749		Outside Hydrogen gas house	Cylinders	40 Lbs	160 Lbs	160 Lbs	No
Alcohol Milsolve	562		Warehouse #3	Barrels	55 Gallons	55 Gallons	55 Gallons	No
Alcohol Milsolve	3671		695 Truck Aisle	Drums	55 Gallons	110 Gallons	55 Gallons	No
Alumina Dessicant	2193		Warehouse #1 (products in 20 and 30 gallons containers)	Drums	30 Gallons	180 Gallons	180 Gallons	No
Alumina Dessicant	2522		Warehouse #1. For air dryer	Drums	55 Gallons	110 Gallons	110 Gallons	No
Ammonium Hydroxide (28%)	1717		Outside Cold Lab. Not an EHS. Liquid is 7.5 lb/gal. Approx. 28% -30% NH3.	Pails	5 Liters	150 Liters	150 Liters	No
Batteries -Lead & Lead Compounds in Lead-Acid	2065		Various areas (warehouse #1 and #8, Turbine and Service Bldg., battery room etc.) Approx. 10.6 lb of Pb/ lb of acid. 10.6 x 4360 lb of acid = 46,200	Battery	Lbs	46,200 Lbs	46,200 Lbs	Yes
Batteries, Sulfuric Acid in Lead Acid Batteries	1744		Various areas (warehouse #1 and #8, Turbine and Service Bldg., battery room etc.) Total = approx. 4360 lb of sulfuric acid.	Battery	Lbs	4360 Lbs	4360 Lbs	Yes
Black Beauty Slag Products	2279		Outside paintshop -south side. Slag used for sand blasting.	Bags	50 Lbs	32,000 Lbs	20,000 Lbs	Yes
Boric Acid (0 - 2%)	553		Reactor coolant system	Flow Through Process Tank	14000 Lbs	14,000 Lbs	7,000 Lbs	Yes
Boric Acid (0 - 2%) Solid	550		Above Laundry area - 755' level, Decon Warehouse #2 and #3.	Bags	50 Lbs	38,000 Lbs	38,000 Lbs	Yes

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Boric Acid (12%)	554		735' auxiliary bldg (121 boric acid batching tank)	Flow Through Process Tank	800 Gallons	800 Gallons	800 Gallons	Yes
Boric Acid (12%)	940		735' auxiliary building (11 boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (12%)	941		735' auxiliary building (121 boric acid storage tank) density =12.3 lb/gal	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (12%)	942		735' auxiliary building (21 boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (6%)	552		Spent fuel pool and refueling storage tank	Other	50000 Lbs	50000 Lbs	50000 Lbs	Yes
Brine, R. O.	1965		Indoor, West of water treatment (flow trough process tank). No EHS. Assumed water density 8.4 lb/gal. Brine concentration in R. O. water 26%	AST	10000 Gallons	10,000 Gallons	10,000 Gallons	No
Carbon Dioxide, Gas	1053		Gas House	Cylinders	60 Lbs	3000 Lbs	3000 Lbs	Yes
Carbon Dioxide, Liquid	1052		Turbine bldg	Tank	12000 Lbs	12,000 Lbs	12,000 Lbs	Yes
Coke, Metallurgical	2369		Bone Yard. Used in turbine bldg sumps to absorb oil. (Note: inventory should include installed coke + amt on-site in drums + amt on-site awaiting	Drums	Lbs	65,000 Lbs	30,000 Lbs	Yes
Diesel Fuel	2015		Tank farm, north of plant near #5 warehouse.	AST	550 Gallons	500 Gallons	250 Gallons	Yes
Diesel Fuel #2	194	194	Inside building east of guard house (day tank for security diesel)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	195	195	Plant screenhouse (#12 diesel cooling water pump day tank)	AST	580 Gallons	575 Gallons	575 Gallons	Yes
Diesel Fuel #2	196	196	Plant screenhouse (# 22 diesel cooling water pump day tank)	AST	580 Gallons	575 Gallons	575 Gallons	Yes
Diesel Fuel #2	197	197	Turbine Bldg. D1 diesel generator fuel oil day tank	AST	500 Gallons	500 Gallons	500 Gallons	Yes

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Alternate Contact: Jeanne Tobias *Work Phone: (651) 388-1121*

24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Diesel Fuel #2	198	198	Turbine bldg (D2 diesel generator fuel oil day tank)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	199	199	Plant screenhouse (fire pump diesel oil day tank)	AST	280 Gallons	200 Gallons	200 Gallons	Yes
Diesel Fuel #2	200	200	D3 Diesel Generator Day Tank	AST	125 Gallons	125 Gallons	100 Gallons	Yes
Diesel Fuel #2	201	201	D4 Diesel Generator Day Tank	AST	125 Gallons	125 Gallons	100 Gallons	Yes
Diesel Fuel #2	210	210	D5/D6 Fuel Oil Receipt Tank, outside near SBO Bldg.	AST	15000 Gallons	15000 Gallons	1000 Gallons	Yes
Diesel Fuel #2	211	211	D5/D6 Fuel Oil Storage Tank - Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	212	212	D5/D6 22 Fuel Oil Storage Tank -Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	213	213	D5/D6 23 Fuel Oil Storage Tank Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	214	214	D5/D6 24 Fuel Oil Storage Tank-Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	218	218	SBO Bldg. 21 Day Tank for D5 Diesel Generator	AST	665 Gallons	665 Gallons	640 Gallons	Yes
Diesel Fuel #2	219	219	SBO Bldg. 22 Day Tank for D6 Diesel Generator	AST	665 Gallons	665 Gallons	640 Gallons	Yes
Diesel Fuel #2	459	121	Plant Screenhouse (diesel fire pump oil storage tank)	UST	4000 Gallons	4000 Gallons	3000 Gallons	Yes
Diesel Fuel #2	460	124	North of Heated Hazwaste building (124 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	461	123	North of Heated Hazwaste building (123 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes

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ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Diesel Fuel #2	462	122	North of Heated Hazwaste building (122 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	463	121	North of Heated Hazwaste building (121 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	464	122	East of turbine building (122 heating boiler oil storage tank)	UST	35000 Gallons	35000 Gallons	25000 Gallons	Yes
Diesel Fuel #2	465	121	East of turbine bldg. (121 heating boiler oil storage tank)	UST	35000 Gallons	35000 Gallons	35000 Gallons	Yes
Diesel Fuel #2	466	122	East of Plant Screenhouse (22 diesel cooling water pump oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	467	121	East of Plant Screenhouse (12 diesel cooling water pump oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Ethylene Glycol (100%)	592		Warehouse #3. Not an EHS. 9.4 lb/gal	Drums	55 Gallons	110 Gallons	110 Gallons	Yes
Ethylene Glycol (50%)	593		D5 & D6 building system, not an EHS	Other	5000 Gallons	4800 Gallons	4600 Gallons	Yes
Ethylene Glycol (50%)	594		Aux bldg, Turbine bldg, Admin Heating system,computer room chiller	Other	3500 Gallons	1200 Gallons	1000 Gallons	Yes
Fleet Charge Antifreeze	1438		Oil room Turbine Bldg., No EHS, 50% ethylene glycol, 9.4 lbs gal	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Formaldehyde various grades (5%, 10% & 37%)	1740		Formaldehyde various grades at PI environmental Laboratory	Pails	5 Gallons	11 Gallons	10 Gallons	No
Freon 113	3672		Warehouse #3, No EHS,	Pails	15 Gallons	90 Gallons	60 Gallons	No
Freon 22	1050		Warehouse #3, (no EHSs) (9.9 lb/gal)	Cylinders	20 Lbs	20 Lbs	20 Lbs	No
Gasoline	2014	2014	Tank farm north of plant, near #5 Warehouse.	AST	550 Gallons	500 Gallons	250 Gallons	No

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24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Halon 1301	1046		Various fire suppression areas; various sizes	Cylinders	Lbs	3731 Lbs	3731 Lbs	No
Hydrazine (1-5%)	3676		Chem Feed U1 and U2 Process piping 175 gallons each, EHS yes, 8.5 lb/gal	Piping	175 Gallons	350 Gallons	350 Gallons	Yes
Hydrazine (35%)	558	3	Outside cold lab. EHS. Liquid = 8.5 lb/gal, Unit 1 Turbine Bldg. 695'	Drums	30 Gallons	120 Gallons	60 Gallons	Yes
Hydrazine 35% Scavox	3675		Decon Warehouse #2, EHS, 8.5 lb/gal	Drums	30 Gallons	270 Gallons	180 Gallons	Yes
Hydrogen Gas	1054		Hydrogen gas house (1 lb / 194 ft3)	Cylinders	261 Cubic Feet	13050 Cubic Feet	13050 Cubic Feet	No
Ice Melt	3707		Various locations inside and outside of plant.	Bags	50 Lbs	2500 Lbs	2500 Lbs	No
Isothiazolin, GE Betz Spectrus 1106	1962		Chem Storage Room, no EHS, 11.62 lb/gal.	Pails	5 Gallons	5 Gallons	5 Gallons	No
Kerosene	781		Warehouse #3, 6.9 lb/gal. Not an EHS.	Pails	5 Gallons	0 Gallons	0 Gallons	No
Kerosene	1718		Warehouse #3, 6.9 lb/gal. Not an EHS.	Drums	55 Gallons	220 Gallons	110 Gallons	No
Molluscide CL-2005, Chemtreat, ZM Molluscide	3685		This product was at the site for 3 days in 4 drums and 4 totes.	Drums	55 Gallons	0 Gallons	0 Gallons	No
Molluscide CL-2005, Chemtreat, ZM Molluscide	3702		This product was at the site for 3 days in 4 drums and 4 totes.	Tote Tank	400 Gallons	3200 Gallons	0 Gallons	Yes
Molybdate Corrosion Inhibitor,GE Betz MD 4106	2914		Unit 2 Turbine Bldg. 715", Decon Warehouse #3 by 2X system.	Drums	55 Gallons	165 Gallons	110 Gallons	No
Nalco 1250, Carbohydrazide	1251		Storage area outside of Cold Lab 695'. No EHSs. 8.7 lb/gal.	Drums	55 Gallons	55 Gallons	55 Gallons	No
Nalco 1318, Sodium Bromide	967	121	Inside chlorine building. 12.2 lb/gal. NaBr = 40%. No EHSs.	AST	1273 Gallons	1273 Gallons	00 Gallons	Yes

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Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Nalco 1336 (Sodium Tolyltriazol)	2915		Chem Storage Room.	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco 39M	1741		Warehouse #2. No EHSs. 9.9 lb/gal. Amts present in 1999 = 5 gal max.	Drums	46.3 Lbs	92.6 Lbs	92.6 Lbs	No
Nalco 39M Corrosion Inhibitor	1205		Warehouse #2, Cold Lab. No EHSs. (9.5 lb/gal).	Drums	5 Gallons	10 Gallons	5 Gallons	No
Nalco 39M Corrosion Inhibitor, Nitrite Based	1433		Chem Storage Room, No EHSs present. 9.5 lb/gal.	Pails	5 Gallons	5 Gallons	5 Gallons	No
Nalco 39M Corrossion Inhibitor, Nitrite Based	3677		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	No
Nalco 7338 (Biocide)	833		Chem Storage Room, No EHSs (9.3 lb/gal)	Pails	5 Gallons	5 Gallons	5 Gallons	No
Nalco 8103 Coagulant	2917		Chem Storage Room, No EHS, 9.1 lbs/gal	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco 8320 (300 ppm Sodium Chromate)	2016		This tank is actualy a "holding" tank for when maintenance is performed on the emergency diesel. No EHSs present. Approx. 8.3 lb/gal This	AST	500 Gallons	500 Gallons	150 Gallons	No
Nalco 8320, Sodium Chromate	910		Warehouse #2, Pure prodct. No EHSs. 14.2 lb/gal.	Drums	30 Gallons	30 Gallons	30 Gallons	No
Nalco 8322 (Corrosion Inhibitor), Molybdate based	223		Warehouse #2. No EHSs or TRI. (9.7 lb/gal). Product replaced with GE BETZ, MD 4106 per J. Tobias 2004 TIER II List.	Drums	55 Gallons	55 Gallons	55 Gallons	No
Nalco 8338 (Nitrite Based corrosion Inhibitor)	2916		Chem Storage Room,	Pails	5 Gallons	10 Gallons	10 Gallons	No
Nalco Glutablehyde, GE Betz Spectrus NX 1105	2156		Chem Storage Room, Not EHS	Pails	5 Gallons	5 Gallons	5 Gallons	No
Nalco Pre-tect 2040 HP (MPA)	1044		Warehouse #2, No EHSs present. 8.1 lb/gal.	Drums	55 Gallons	200 Gallons	165 Gallons	No
Nalco Pre-tect 2040 HP (MPA)	3673		Chem Feed fume hood both units	Drums	55 Gallons	110 Gallons	110 Gallons	No

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Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Nalco Pre-tect 2040 HP (MPA)	3674		Cold Lab storage area, No EHS	Drums	55 Gallons	110 Gallons	110 Gallons	No
Nalco Spectrus NX 1105	1686		Warehouse #2	Fiber Drums	43 Lbs	172 Lbs	86 Lbs	No
Nitrogen Gas	3750		Gas House	Cylinders	60 Gallons	3000 Gallons	3000 Gallons	Yes
Nitrogen, Liquid	555		East of turbine building	Tank	1500 Gallons	1500 Gallons	1500 Gallons	Yes
Nitrogen, Liquid	556		East of turbine building	Tank	1500 Gallons	1500 Gallons	1500 Gallons	Yes
Oil Mobil SHC 525	3689		Warehouse #3	Drums	55 Gallons	330 Gallons	330 Gallons	Yes
Oil Mobil, Voetra Oil #2	3684		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil SAE 15W-40W Soot Control	3682		Warehouse #3	Drums	55 Gallons	1265 Gallons	1265 Gallons	Yes
Oil, Caltran Transformer	3680		Warehouse #3	Drums	55 Gallons	0 Gallons	0 Gallons	Yes
Oil, Delvac 1330	3683		Warehouse #3	Drums	55 Gallons	0 Gallons	0 Gallons	Yes
Oil, Delvac 1630	2967		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Diesel Lube	572		Plant Screenhouse (#12 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	110 Gallons	100 Gallons	Yes
Oil, Diesel Lube	573		Plant Screenhouse (#22 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	110 Gallons	100 Gallons	Yes
Oil, Diesel Lube	576		Turbine building (D1 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes

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Oil, Diesel Lube	577		Turbine building (D2 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	579		D3 building south of reactor (D3 diesel generator crankcase). East of Turbine Bldg.	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	580		D4 building south of reactor (D4 diesel generator crankcase). East of Turbine Bldg.	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, DTE 24	2966		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE 25	2968		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE 25	3701		Warehouse #3	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, DTE Oil BB SAE 40	2957		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil BB SAE 40	3694		Warehouse #3	Drums	55 Gallons	330 Gallons	165 Gallons	Yes
Oil, DTE Oil Extra Heavy SAE 30	2960		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Extra Heavy SAE 30	3695		Warehouse #3	Drums	55 Gallons	495 Gallons	165 Gallons	Yes
Oil, DTE Oil Heavy	2961		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Heavy	3696		Warehouse #3	Drums	55 Gallons	330 Gallons	275 Gallons	Yes
Oil, DTE Oil Heavy Medium SAE 20	3697		Warehouse #3	Drums	55 Gallons	330 Gallons	330 Gallons	Yes
Oil, DTE Oil Heavy Medium SAE 20	3698		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes

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Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Oil, DTE Oil Heavy Medium SAE 20	3699		Oil Room in Turbine Bldg.	Tank	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Light SAE 10	3700		Warehouse #3	Drums	55 Gallons	275 Gallons	220 Gallons	Yes
Oil, DTE Oil Medium	2963		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil, SAE10	2964		Oil Room in Turbine Unit1 Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Duragard Super HD 15W40	1328		Oil Room, Turbine Bldg., No EHS	Drums	55 Gallons	55 Gallons	55 Gallons	No
Oil, Duragard Super HD 15W-40	2956		Oil Room in Turbine Bldg	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, EHC	3681		Warehouse #3, No EHS	Drums	55 Gallons	110 Gallons	110 Gallons	Yes
Oil, Fryquel EHC Hydraulic Fluid	1336		Oil Room in Turbine Bldg. Not an EHS. (9.5 lb/gal)	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Gargoyle, SHC 224	3678		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Lube	220		SBO Building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	850 Gallons	800 Gallons	Yes
Oil, Lube	221	22	SBO Building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	850 Gallons	800 Gallons	Yes
Oil, Mobil 450 NC	3686		warehouse #3	Drums	55 Gallons	1265 Gallons	880 Gallons	Yes
Oil, Mobil 450 NC	3687		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Mobil Gard 629	2958		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***
ERC ID#: 25-150-0001

Contact Person: Joan Neubauer *Work Phone: (651) 388-1121*
Alternate Contact: Jeanne Tobias *Work Phone: (651) 388-1121*
24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Oil, Mobil Gard 629	3690		Warehouse #3	Drums	55 Gallons	0 Gallons	0 Gallons	Yes
Oil, Mobil Rarus 827	2965		Oil Room in Turbine Bldg. 695' Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC 525	3688		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Mobil SHC 630	1746		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC 630	3691		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Mobil SHC 824	3692		Warehouse #3	Drums	55 Gallons	1045 Gallons	990 Gallons	Yes
Oil, Mobil -SHC 824	3693		Oil Room in Turbine Bldg.	Drums	55 Gallons	110 Gallons	55 Gallons	Yes
Oil, Mobil SHC-525	2970		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC-632	2969		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobile SHC 630	2955		Oil Room in Turbine Blg 695'. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobilgard 450 NC	2959		Oil Room Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Stoage Tank, Turbine Lube Oil 1-2	584	584	Oil Room in Turbine Bldg.	AST	14000 Gallons	14000 Gallons	10000 Gallons	Yes
Oil, Turbine Lube	586	11	Turbine building (#1 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	14000 Gallons	13000 Gallons	Yes
Oil, Turbine Lube	587	21	Turbine building (#2 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	14000 Gallons	13000 Gallons	Yes

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Alternate Contact: Jeanne Tobias *Work Phone: (651) 388-1121*

24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Oil, Turbine Lube (Make Up Tank)	585	585	Oil Room in Turbine Bldg.	AST	2000 Gallons	2000 Gallons	1500 Gallons	Yes
Oil, Used	202	202	Outside west of plant (Used Oil Tank).	AST	5000 Gallons	1000 Gallons	1000 Gallons	Yes
Oil, Used	203	203	Outside west of plant (Used Oil Tank).	AST	5000 Gallons	1000 Gallons	1000 Gallons	Yes
Oil, Used	217	217	Oil Room Turbine Bldg.	AST	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Whiterex 425	3679		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oxygen, Liquid	1056		Turbine bldg	Dewars	25 Gallons	50 Gallons	35 Gallons	No
Propane	588		West of plant	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	589		West of plant. Used for NPD heat. No EHSs present. 4.2 lb/gal.	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	590		West of plant, Used for NPD Bldg. heat.	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	1657		Met tower bldg	Tank	250 Gallons	250 Gallons	250 Gallons	Yes
Propane Gas	3751		Outside Hydrogen Gas and other locations	Cylinders	50 Lbs	100 Lbs	100 Lbs	Yes
Resin, Amberlite IRN-217, Rohm and Haas	3703		Decon Warehouse #2.	Pails	138 Lbs	5950 Lbs	5950 Lbs	No
Resin, Clinophthilonite, Fisher	3706		Decon Warehouse #2.	Pails	1 Cubic Feet	21 Cubic Feet	21 Cubic Feet	No
Resin, PD-11-NH4, Epicor	3704		Decon Warehouse #2	Pails	28 Lbs	700 Lbs	700 Lbs	No

EPCRA SECTION 312 (TIER II)
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Alternate Contact: Jeanne Tobias *Work Phone: (651) 388-1121*

24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Resins, Demineralizer	1327		Various Locations (installed and in stock). Includes: Epicor anion, cation and mixed bed resins. No EHSs. 10.0 lb/gal	Fiber Drums & Flow Thru Process Tanks	Lbs	37000 Lbs	37000 Lbs	Yes
Resins, PD-32-NH4, Epicor	3705		Decon Warehouse #2.	Pails	28 Lbs	728 Lbs	728 Lbs	No
Salt (Sodium Chloride)	2296		Training center and various plant areas and turbine bldg. No EHSs present.	Bags	50 Lbs	2000 Lbs	2000 Lbs	No
Sodium Bisulfate	1743		Warehouse #2, Not an EHS.Water Treatment Cleaning	Drums	100 Lbs	0 Lbs	0 Lbs	No
Sodium Carbonate	1742		Warehouse #2.	Pails	50 Lbs	0 Lbs	0 Lbs	No
Sodium Hydroxide (10%)	206	11	Inside auxiliary bldg (caustic standpipe - unit 1). Not an EHS. Approx. 8.3 lb/gal.	AST	2700 Gallons	2700 Gallons	2600 Gallons	Yes
Sodium Hydroxide (10%)	207	21	Inside auxiliary bldg (caustic standpipe - unit 2)	AST	2700 Gallons	2700 Gallons	2600 Gallons	Yes
Sodium Hydroxide (10%)	2274		Warehouse #2.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Sodium Hydroxide (Flakes)	1434		Warehouse #2	Drums	187 Lbs	374 Lbs	374 Lbs	Yes
Sodium Hypochlorite (15%)	215	121	Inside chlorine bldg (bulk sodium hypochlorite tank) No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	1273 Gallons	600 Gallons	Yes
Sodium Hypochlorite (15%)	966	122	Inside chlorine building (bulk sodium hypochlorite tank). No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	1273 Gallons	600 Gallons	Yes
Sodium Sulfite	1332		Storage area outside Cold Lab. Not EHS or TRI. 21.6 lb/gal. Bleach used for spill clean-up.	Pails	100 Lbs	200 Lbs	100 Lbs	No
Stoddard Solvent	563		Warehouse #3, 695' level, truck isle. No EHS. 6.5 lb/gal	Barrels	55 Gallons	0 Gallons	0 Gallons	No
Sulfur Hexaflouride	841		Substation bldg. Several small cylinders. Not an EHS.	Cylinders	480 Lbs	480 Lbs	360 Lbs	No

EPCRA SECTION 312 (TIER II)
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EPA Reporting Year: 2007

Plant: ***Prairie Island Generating Plant***
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Alternate Contact: Jeanne Tobias *Work Phone: (651) 388-1121*
24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2007?
Zep Dyna 143	1655		Warehouse #3 and in two parts washers. Installed late in 1998. 6.5 lb/gal. No EHSs.	Drums	20 Gallons	120 Gallons	80 Gallons	No

This report was used as the basis for your facility's EPCRA Section 312 hazardous substance inventory (TIER II) submittal in 2008. Please keep this report in your EPCRA 312 file for at least 5 years. If there are any questions, contact Jayshree Desai in ERAD at 612-337-2243.

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***

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Alternate Contact: Jeanne Tobias *Work Phone: (651) 388-1121*

24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Acetone	561		Warehouse #3,	Drums	55 Gallons	165 Gallons	110 Gallons	No
Acetone	3670		695 Truck Aisle, No EHS	Drums	55 Gallons	55 Gallons	55 Gallons	No
Alcohol Milsolve	562		Warehouse #3	Barrels	55 Gallons	55 Gallons	55 Gallons	No
Alcohol Milsolve	3671		695 Truck Aisle	Drums	55 Gallons	110 Gallons	55 Gallons	No
Alumina Dessicant	2522		Warehouse #1. For air dryer	Drums	55 Gallons	110 Gallons	110 Gallons	No
Ammonium Hydroxide (28%)	1717		Outside Cold Lab. Not an EHS. Liquid is 7.5 lb/gal. Approx. 28% -30% NH3.	Pails	5 Liters	10 Liters	5 Liters	No
Batteries -Lead & Lead Compounds in Lead-Acid	2065		Various areas (warehouse #1 and #8, Turbine and Service Bldg., battery room etc.) Approx. 10.6 lb of Pb/ lb of acid. 10.6 x 4360 lb of acid = 46,200	Battery	Lbs	46,200 Lbs	46,200 Lbs	Yes
Batteries, Sulfuric Acid in Lead Acid Batteries	1744		Various areas (warehouse #1 and #8, Turbine and Service Bldg., battery room etc.) Total = approx. 4360 lb of sulfuric acid.	Battery	Lbs	4360 Lbs	4360 Lbs	Yes
Black Beauty Slag Products	2279		Outside paintshop -south side. Slag used for sand blasting.	Bags	50 Lbs	32,000 Lbs	20,000 Lbs	Yes
Boric Acid (0 - 2%)	553		Reactor coolant system	Flow Through Process Tank	14000 Lbs	14,000 Lbs	7,000 Lbs	Yes
Boric Acid (0 - 2%) Solid	550		Above Laundry area - 755' level, Decon Warehouse #2 and #3.	Bags	50 Lbs	38,000 Lbs	38,000 Lbs	Yes
Boric Acid (12%)	554		735' auxiliary bldg (121 boric acid batching tank)	Flow Through Process Tank	800 Gallons	800 Gallons	800 Gallons	Yes
Boric Acid (12%)	940		735' auxiliary building (11 boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (12%)	941		735' auxiliary building (121 boric acid storage tank) density =12.3 lb/gal	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes

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ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Boric Acid (12%)	942		735' auxiliary building (21 boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (6%)	552		Spent fuel pool and refueling storage tank	Other	50000 Lbs	50000 Lbs	50000 Lbs	Yes
Brine, R. O.	1965		Indoor, West of water treatment (flow trough process tank). No EHS. Assumed water density 8.4 lb/gal. Brine concentration in R. O. water 26%	AST	10000 Gallons	10,000 Gallons	10,000 Gallons	No
Carbon Dioxide, Gas	1053		Gas House	Cylinders	60 Lbs	3000 Lbs	3000 Lbs	Yes
Carbon Dioxide, Liquid	1052		Turbine bldg	Tank	12000 Lbs	12,000 Lbs	12,000 Lbs	Yes
Coke, Metallurgical	2369		Bone Yard. Used in turbine bldg sumps to absorb oil. (Note: inventory should include installed coke + amt on-site in drums + amt on-site awaiting	Drums	Lbs	65,000 Lbs	30,000 Lbs	Yes
Diesel Fuel	2015		Tank farm, north of plant near #5 warehouse.	AST	550 Gallons	500 Gallons	250 Gallons	Yes
Diesel Fuel #2	194	194	Inside building east of guard house (day tank for security diesel)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	195	195	Plant screenhouse (#12 diesel cooling water pump day tank)	AST	580 Gallons	575 Gallons	575 Gallons	Yes
Diesel Fuel #2	196	196	Plant screenhouse (# 22 diesel cooling water pump day tank)	AST	580 Gallons	575 Gallons	575 Gallons	Yes
Diesel Fuel #2	197	197	Turbine Bldg. D1 diesel generator fuel oil day tank	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	198	198	Turbine bldg (D2 diesel generator fuel oil day tank)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	199	199	Plant screenhouse (fire pump diesel oil day tank)	AST	280 Gallons	200 Gallons	200 Gallons	Yes
Diesel Fuel #2	200	200	D3 Diesel Generator Day Tank	AST	125 Gallons	125 Gallons	100 Gallons	Yes

EPCRA SECTION 312 (TIER II)
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ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Diesel Fuel #2	201	201	D4 Diesel Generator Day Tank	AST	125 Gallons	125 Gallons	100 Gallons	Yes
Diesel Fuel #2	210	210	D5/D6 Fuel Oil Receipt Tank, outside near SBO Bldg.	AST	15000 Gallons	15000 Gallons	1000 Gallons	Yes
Diesel Fuel #2	211	211	D5/D6 Fuel Oil Storage Tank - Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	212	212	D5/D6 22 Fuel Oil Storage Tank -Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	213	213	D5/D6 23 Fuel Oil Storage Tank Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	214	214	D5/D6 24 Fuel Oil Storage Tank-Vault	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	218	218	SBO Bldg. 21 Day Tank for D5 Diesel Generator	AST	665 Gallons	665 Gallons	640 Gallons	Yes
Diesel Fuel #2	219	219	SBO Bldg. 22 Day Tank for D6 Diesel Generator	AST	665 Gallons	665 Gallons	640 Gallons	Yes
Diesel Fuel #2	459	121	Plant Screenhouse (diesel fire pump oil storage tank)	UST	4000 Gallons	4000 Gallons	3000 Gallons	Yes
Diesel Fuel #2	460	124	North of Heated Hazwaste building (124 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	461	123	North of Heated Hazwaste building (123 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	462	122	North of Heated Hazwaste building (122 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	463	121	North of Heated Hazwaste building (121 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	464	122	East of turbine building (122 heating boiler oil storage tank)	UST	35000 Gallons	35000 Gallons	25000 Gallons	Yes

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ERC ID#: 25-150-0001	*24 hr #: (651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Diesel Fuel #2	465	121	East of turbine bldg. (121 heating boiler oil storage tank)	UST	35000 Gallons	35000 Gallons	35000 Gallons	Yes
Diesel Fuel #2	466	122	East of Plant Screenhouse (22 diesel cooling water pump oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	467	121	East of Plant Screenhouse (12 diesel cooling water pump oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Ethylene Glycol (100%)	592		Warehouse #3. Not an EHS. 9.4 lb/gal	Drums	55 Gallons	850 Gallons	550 Gallons	Yes
Ethylene Glycol (50%)	593		D5 & D6 building system, not an EHS	Other	5000 Gallons	4800 Gallons	4600 Gallons	Yes
Ethylene Glycol (50%)	594		Aux bldg, Turbine bldg, Admin Heating system,computer room chiller	Other	3500 Gallons	3000 Gallons	1400 Gallons	Yes
Formaldehyde various grades (5%, 10% & 37%)	1740		Formaldehyde various grades at PI environmental Laboratory	Pails	5 Gallons	11 Gallons	10 Gallons	No
Freon 11	1048		Not an EHS. NOT REPORTABLE in 2007.	Drums	200 Lbs	200 Lbs	200 Lbs	No
Freon 113	3672		Warehouse #3, No EHS,	Pails	15 Gallons	30 Gallons	30 Gallons	No
Freon 22	1050		Warehouse #3, (no EHSs) (9.9 lb/gal)	Cylinders	20 Lbs	100 Lbs	100 Lbs	No
Gasoline	2014	2014	Tank farm north of plant, near #5 Warehouse.	AST	550 Gallons	500 Gallons	250 Gallons	No
Halon 1301	1046		Various fire suppression areas; various sizes	Cylinders	Lbs	3731 Lbs	3731 Lbs	No
Hydrazine (1-5%)	3676		Chem Feed U1 and U2 Process piping 175 gallons each, EHS yes, 8.5 lb/gal	Piping	175 Gallons	350 Gallons	350 Gallons	Yes
Hydrazine (35%)	557		Decon Warehouse, duplicate removed per Joan N. on 1/11//08.	Drums	30 Gallons	300 Gallons	200 Gallons	Yes

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24 hr #: (651) 388-5577

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Hydrazine (35%)	558	3	Outside cold lab. EHS. Liquid = 8.5 lb/gal, Unit 1 Turbine Bldg. 695'	Drums	30 Gallons	120 Gallons	60 Gallons	Yes
Hydrazine 35% Scavox	3675		Decon Warehouse #2, EHS, 8.5 lb/gal	Drums	30 Gallons	6600 Gallons	3300 Gallons	Yes
Hydrochloric Acid	837		Chem Storage Room, cold lab 695'; hot lab (exempt), removed per Joan N. 1/10/08.	Glass Bottles	0.5 Gallons	4 Gallons	2 Gallons	No
Hydrogen Gas	1054		Hydrogen gas house (1 lb / 194 ft3)	Cylinders	261 Cubic Feet	13050 Cubic Feet	13050 Cubic Feet	No
Isothiazolin, GE Betz Spectrus 1106	1962		Chem Storage Room, no EHS, 11.62 lb/gal.	Pails	5 Gallons	5 Gallons	5 Gallons	No
Kerosene	781		Warehouse #3, 6.9 lb/gal. Not an EHS.	Pails	5 Gallons	50 Gallons	40 Gallons	No
Kerosene	1718		Warehouse #3, 6.9 lb/gal. Not an EHS.	Drums	55 Gallons	220 Gallons	110 Gallons	No
Molluscide CL-2005, Chemtreat, ZM Molluscide	3685		This product was at the site for 3 days in 4 drums and 4 totes.	Drums	55 Gallons	220 Gallons	0 Gallons	No
Molluscide CL-2005, Chemtreat, ZM Molluscide	3702		This product was at the site for 3 days in 4 drums and 4 totes.	Tote Tank	400 Gallons	1600 Gallons	0 Gallons	Yes
Molybdate Corrosion Inhibitor,GE Betz MD 4106	2914		Unit 2 Turbine Bldg. 715", Decon Warehouse #3 by 2X system.	Drums	55 Gallons	385 Gallons	385 Gallons	No
Nalco 1250, Carbohydrazide	1251		Storage area outside of Cold Lab 695'. No EHSs. 8.7 lb/gal.	Drums	55 Gallons	110 Gallons	55 Gallons	No
Nalco 1318, Sodium Bromide	967	121	Inside chlorine building. 12.2 lb/gal. NaBr = 40%. No EHSs.	AST	1273 Gallons	1273 Gallons	500 Gallons	Yes
Nalco 1336 (Sodium Tolyltriazol)	2915		Chem Storage Room.	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco 39M Corrosion Inhibitor, Nitrite Based	1433		Chem Storage Room, No EHSs present. 9.5 lb/gal.	Pails	5 Gallons	55 Gallons	30 Gallons	No

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ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Nalco 39M Corrosion Inhibitor, Nitrite Based	3677		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	No
Nalco 7338 (Biocide)	833		Chem Storage Room, No EHSs (9.3 lb/gal)	Pails	5 Gallons	10 Gallons	10 Gallons	No
Nalco 8103 Coagulant	2917		Chem Storage Room, No EHS, 9.1 lbs/gal	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco 8320 (300 ppm Sodium Chromate)	2016		This tank is actualy a "holding" tank for when maintenance is performed on the emergency diesel. No EHSs present. Approx. 8.3 lb/gal This	AST	500 Gallons	500 Gallons	150 Gallons	No
Nalco 8320, Sodium Chromate	910		Warehouse #2, Pure prodct. No EHSs. 14.2 lb/gal.	Drums	30 Gallons	30 Gallons	30 Gallons	No
Nalco 8338 (Nitrite Based corrosion inhibitor)	2916		Chem Storage Room,	Pails	5 Gallons	15 Gallons	15 Gallons	No
Nalco Glutablehyde, GE Betz Spectrus NX 1105	2156		Chem Storage Room, Not EHS	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco Pre-tect 2040 HP (MPA)	1044		Warehouse #2, No EHSs present. 8.1 lb/gal.	Drums	55 Gallons	4050 Gallons	2035 Gallons	No
Nalco Pre-tect 2040 HP (MPA)	3673		Chem Feed fume hood both units	Drums	55 Gallons	110 Gallons	110 Gallons	No
Nalco Pre-tect 2040 HP (MPA)	3674		Cold Lab storage area, No EHS	Drums	55 Gallons	110 Gallons	110 Gallons	No
Nitrogen, Liquid	555		East of turbine building	Tank	1500 Gallons	1500 Gallons	1500 Gallons	Yes
Nitrogen, Liquid	556		East of turbine building	Tank	1500 Gallons	1500 Gallons	1500 Gallons	Yes
Oil Mobil SHC 525	3689		Warehouse #3	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil Mobil, Voetra Oil #2	3684		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes

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	Alternate Contact: *Jeanne Tobias*	*Work Phone:* *(651) 388-1121*
ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Oil SAE 15W-40W Soot Control	3682		Warehouse #3	Drums	55 Gallons	2035 Gallons	2035 Gallons	Yes
Oil, Caltran Transformer	3680		Warehouse #3	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Delvac 1330	3683		Warehouse #3	Drums	55 Gallons	100 Gallons	55 Gallons	Yes
Oil, Delvac 1630	2967		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Diesel Lube	572		Plant Screenhouse (#12 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	110 Gallons	100 Gallons	Yes
Oil, Diesel Lube	573		Plant Screenhouse (#22 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	110 Gallons	100 Gallons	Yes
Oil, Diesel Lube	576		Turbine building (D1 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	577		Turbine building (D2 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	579		D3 building south of reactor (D3 diesel generator crankcase). East of Turbine Bldg.	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	580		D4 building south of reactor (D4 diesel generator crankcase). East of Turbine Bldg.	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, DTE 24	2966		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE 25	2968		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE 25	3701		Warehouse #3	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, DTE Oil BB SAE 40	2957		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***
ERC ID#: 25-150-0001

Contact Person: Joan Neubauer
Alternate Contact: Jeanne Tobias
24 hr #: (651) 388-5577

Work Phone: (651) 388-1121
Work Phone: (651) 388-1121

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Oil, DTE Oil BB SAE 40	3694		Warehouse #3	Drums	55 Gallons	330 Gallons	330 Gallons	Yes
Oil, DTE Oil Extra Heavy SAE 30	2960		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Extra Heavy SAE 30	3695		Warehouse #3	Drums	55 Gallons	495 Gallons	495 Gallons	Yes
Oil, DTE Oil Heavy	2961		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Heavy	3696		Warehouse #3	Drums	55 Gallons	330 Gallons	330 Gallons	Yes
Oil, DTE Oil Heavy Medium SAE 20	3697		Warehouse #3	Drums	55 Gallons	165 Gallons	165 Gallons	Yes
Oil, DTE Oil Heavy Medium SAE 20	3698		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, DTE Oil Heavy Medium SAE 20	3699		Oil Room in Turbine Bldg.	Tank	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Light SAE 10	3700		Warehouse #3	Drums	55 Gallons	275 Gallons	275 Gallons	Yes
Oil, DTE Oil Medium	2963		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil, SAE10	2964		Oil Room in Turbine Unit1 Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Duragard Super HD 15W-40	2956		Oil Room in Turbine Bldg	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, EHC	3681		Warehouse #3, No EHS	Drums	55 Gallons	275 Gallons	275 Gallons	Yes
Oil, Fryquel EHC Hydraulic Fluid	1336		Oil Room in Turbine Bldg. Not an EHS. (9.5 lb/gal)	Drums	55 Gallons	110 Gallons	55 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***	*Contact Person: Joan Neubauer*	*Work Phone: (651) 388-1121*
	Alternate Contact: Jeanne Tobias	*Work Phone: (651) 388-1121*
ERC ID#: 25-150-0001	*24 hr #: (651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Oil, Gargoyle, SHC 224	3678		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Lube	220		SBO Building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	850 Gallons	800 Gallons	Yes
Oil, Lube	221	22	SBO Building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	850 Gallons	800 Gallons	Yes
Oil, Mobil 450 NC	3686		warehouse #3	Drums	55 Gallons	1265 Gallons	1265 Gallons	Yes
Oil, Mobil 450 NC	3687		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Mobil Gard 629	2958		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil Gard 629	3690		Warehouse #3	Drums	55 Gallons	440 Gallons	440 Gallons	Yes
Oil, Mobil Rarus 827	2965		Oil Room in Turbine Bldg. 695' Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC 525	3688		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Mobil SHC 630	1746		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC 630	3691		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oil, Mobil SHC 824	3692		Warehouse #3	Drums	55 Gallons	1045 Gallons	1045 Gallons	Yes
Oil, Mobil -SHC 824	3693		Oil Room in Turbine Bldg.	Drums	55 Gallons	110 Gallons	55 Gallons	Yes
Oil, Mobil SHC-525	2970		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

EPA Reporting Year: 2006

Plant: ***Prairie Island Generating Plant***	*Contact Person: Joan Neubauer*	*Work Phone: (651) 388-1121*
	Alternate Contact: Jeanne Tobias	*Work Phone: (651) 388-1121*
ERC ID#: 25-150-0001	*24 hr #: (651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Oil, Mobil SHC-632	2969		Oil Room in Turbine Bldg.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobile SHC 630	2955		Oil Room in Turbine Blg 695'. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobilgard 450 NC	2959		Oil Room Turbine Bldg.	AST	100 Gallons	55 Gallons	55 Gallons	Yes
Oil, Stoage Tank, Turbine Lube Oil 1-2	584	584	Oil Room in Turbine Bldg.	AST	14000 Gallons	14000 Gallons	10000 Gallons	Yes
Oil, Turbine Lube	586	11	Turbine building (#1 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	14000 Gallons	13000 Gallons	Yes
Oil, Turbine Lube	587	21	Turbine building (#2 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	14000 Gallons	13000 Gallons	Yes
Oil, Turbine Lube (Make Up Tank)	585	585	Oil Room in Turbine Bldg.	AST	2000 Gallons	2000 Gallons	1500 Gallons	Yes
Oil, Used	202	202	Outside west of plant (Used Oil Tank).	AST	5000 Gallons	3500 Gallons	1500 Gallons	Yes
Oil, Used	203	203	Outside west of plant (Used Oil Tank).	AST	5000 Gallons	3500 Gallons	1500 Gallons	Yes
Oil, Used	217	217	Oil Room Turbine Bldg.	AST	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Whiterex 425	3679		Oil Room in Turbine Bldg.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Oxygen, Liquid	1056		Turbine bldg	Dewars	25 Gallons	50 Gallons	35 Gallons	No
Propane	588		West of plant	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	589		West of plant. Used for NPD heat. No EHSs present. 4.2 lb/gal.	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***	*Contact Person:* *Joan Neubauer*	*Work Phone:* *(651) 388-1121*
	Alternate Contact: *Jeanne Tobias*	*Work Phone:* *(651) 388-1121*
ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Propane	590		West of plant, Used for NPD Bldg. heat.	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	1657		Met tower bldg	Tank	250 Gallons	250 Gallons	250 Gallons	Yes
Resin, Amberlite IRN-217, Rohm and Haas	3703		Decon Warehouse #2.	Pails	138 Lbs	71 Lbs	36 Lbs	No
Resin, Clinophthilonite, Fisher	3706		Decon Warehouse #2.	Pails	1 Cubic Feet	21 Cubic Feet	21 Cubic Feet	No
Resin, PD-11-NH4, Epicor	3704		Decon Warehouse #2	Pails	28 Lbs	40 Lbs	40 Lbs	No
Resins, Demineralizer	1327		Various Locations (installed and in stock). Includes: Epicor anion, cation and mixed bed resins. No EHSs. 10.0 lb/gal	Fiber Drums & Flow Thru Process Tanks	Lbs	37000 Lbs	37000 Lbs	Yes
Resins, PD-32-NH4, Epicor	3705		Decon Warehouse #2.	Pails	28 Lbs	100 Lbs	100 Lbs	No
Salt (Sodium Chloride)	2296		Training center and various plant areas and turbine bldg. No EHSs present.	Bags	50 Lbs	2000 Lbs	2000 Lbs	No
Sodium Bisulfate	1743		Warehouse #2, Not an EHS.Water Treatment Cleaning	Drums	100 Lbs	100 Lbs	100 Lbs	No
Sodium Carbonate	1742		Warehouse #2.	Pails	50 Lbs	50 Lbs	50 Lbs	No
Sodium Hydroxide (10%)	206	11	Inside auxiliary bldg (caustic standpipe - unit 1). Not an EHS. Approx. 8.3 lb/gal.	AST	2700 Gallons	2700 Gallons	2600 Gallons	Yes
Sodium Hydroxide (10%)	207	21	Inside auxiliary bldg (caustic standpipe - unit 2)	AST	2700 Gallons	2700 Gallons	2600 Gallons	Yes
Sodium Hydroxide (10%)	2274		Warehouse #2.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes
Sodium Hypochlorite (15%)	215	121	Inside chlorine bldg (bulk sodium hypochlorite tank) No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	1273 Gallons	600 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

EPA Reporting Year: 2006

Plant: ***Prairie Island Generating Plant***	*Contact Person:* *Joan Neubauer*	*Work Phone:* *(651) 388-1121*
	Alternate Contact: *Jeanne Tobias*	*Work Phone:* *(651) 388-1121*
ERC ID#: *25-150-0001*	*24 hr #:* *(651) 388-5577*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2006?
Sodium Hypochlorite (15%)	966	122	Inside chlorine building (bulk sodium hypochlorite tank). No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	1273 Gallons	600 Gallons	Yes
Sodium Sulfite	1332		Storage area outside Cold Lab. Not EHS or TRI. 21.6 lb/gal. Bleach used for spill clean-up.	Pails	100 Lbs	100 Lbs	100 Lbs	No
Stoddard Solvent	563		Warehouse #3, 695' level, truck isle. No EHS. 6.5 lb/gal	Barrels	55 Gallons	275 Gallons	165 Gallons	No
Sulfur Hexaflouride	841		Substation bldg. Several small cylinders. Not an EHS.	Cylinders	480 Lbs	480 Lbs	360 Lbs	No
Zep Dyna 143	1655		Warehouse #3 and in two parts washers. Installed late in 1998. 6.5 lb/gal. No EHSs.	Drums	20 Gallons	220 Gallons	110 Gallons	No

This report was used as the basis for your facility's EPCRA Section 312 hazardous substance inventory (TIER II) submittal in 2008. Please keep this report in your EPCRA 312 file for at least 5 years. If there are any questions, contact Bruce Denney in ERAD at 612-337-2085.

Submitted 2006

MINNESOTA EMERGENCY RESPONSE COMMISSION

444 CEDAR ST., SUITE 223, ST. PAUL, MN 55101
PHONE: (651) 297-7372 TTY (651) 282-6555
FAX (651) 296-0459

HAZARDOUS CHEMICAL REPORT

MINNESOTA COMMUNITY RIGHT-TO-KNOW
40 CFR PART 370 SUBPART B
(SECTION 311 REPORTING REQUIREMENT)

A Facility Identification

ERC ID#: 25--150--0001 SIC Code: 4911

Facility Name: Prairie Island Nuclear Generating Plant

Street Address: 1717 Wakonade Dr.	Mailing Address: (If different from Street Address) 414 Nicollet Mall
City, State, Zip Code: Welch, MN 55089	P.O. Box #: Ren Sq-8
County: Goodhue County	City, State, Zip Code: Minneapolis, MN 55402
Primary Contact: Jeanne Tobias	Alternate Contact: Jeff LeClair
Telephone: 651-998--4626	Telephone: 651-388--1121

B Accompanying Information

40 CFR part 370.21 requires facilities to provide either material safety data sheets (MSDS's) or a list of chemical materials present at this facility in excess of the current "minimum threshold quantity" if you are required to prepare or maintain such MSDS's by OSHA.

1. Is this an initial submittal or an update? (Check one) ☐ Initial ☑ Update

2. Are you submitting MSDS's or a list? (Check one) ☐ MSDS ☑ List

3. Are any of these materials on the list of "Extremely Hazardous Substances" and present in excess of the "Threshold Planning Quantity" as defined in 40 CFR Part 355, published in the Federal Register April 22, 1987? (Check one) ☐ Yes ☑ No

4. Has a copy of the submittal been sent by you to your local fire department? (Check one) ☑ Yes ☐ No

5. What is the name and address of your local Fire Department?
Redwing Fire Dept. 420 Plum St. Redwing, MN 55066

C Recommended List Format

Computer printouts or typed lists are also acceptable.

HAZARD CATEGORY (Check all that apply)					COLUMN I	COLUMN II
Immediate (acute) health	Delayed (chronic) health	Fire	Sudden Pressure Release	Reactivity	Chemical or Common Name	Hazardous Components as provided on the MSDS
✓	✓	✓			Petroleum Asphalt	8052-42-4 Petroleum Asphalt (20-40%)
						7738-06-4 Traces of Hydrogen Silde -10 ppm
						8052-41-3 Mineral Spirit - 100 ppm

PS - 04000-03 (3/00)

Continue list on back or additional forms

Tier II Emergency and Hazardous Chemical Inventory

Reporting Period From January 2005 to December 2005

Print Set page to landscape before printing

Facility Identification

Name: XCEL ENERGY - PRAIRIE ISLAND PLANT
Street: 1717 WAKONADE DRV E
City: WELCH County: Goodhue
State: MN Zip: 55089
Phone: 6123372243 Lat/Long: 44.6279983520508/92.6579971313477

Owner/Operator Name

Name: Xcel Energy
Phone: 612-337-2243
Mail Address: 414 Nicollet Ave
City: Minneapolis State: MN
Zip: 55402 Country: United States

Mailing Address if different from Facility ID Address

Name: XCEL ENERGY - PRAIRIE ISLAND PLANT
Street: 414 NICOLLET MALL (RS-8)
PO Box: City: MINNEAPOLIS
State: MN Zip: 55401
Attn: JAYSHREE DESAI
SIC Code: 4911 Dun & Brad No#:
NAICS: ERC ID Number 251500001

Emergency Contact

Name: Jeanne Tobias
Title: Env Contact -NMC PI
Phone: 6513881121x4626 24 Hr. Phone: 651-998-4251
Name: Jeff LeClair
Title:
Phone: 6513881121 24 Hr.Phone:

Mixture Components are listed in the Appendix.

Chemical Description

CAS: 7664-93-9
Trade Secret: No
Chem.Name: SULFURIC ACID
EHS Name:
Check all that apply:
☒Pure ☐Mix ☐Solid ☒Liquid ☐Gas ☒EHS

Physical and Health Hazards

☐Fire
☐Pressure
☐Reactivity
☒Immediate
☒Delayed (Chronic)

Inventory

04 Max Daily Amount Code
04 Ave. Daily Amount Code
365 No. of days on site

Storage Codes & Locations

Con. Type	Press.	Temp	Storage Location
C	1	4	E side of plant; chemical storeroom; chemical labs; LEAD ACID BATTERIES
M	1	4	E side of plant; chemical storeroom; chemical labs; LEAD ACID BATTERIES
R	1	4	E side of plant; chemical storeroom; chemical labs; LEAD ACID BATTERIES

Certification: I certify under penalty of law that I have personally examined and am familiar with the information submitted, and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

Jayshree Desai , Env. Analyst 2/26/2006 9:23:22 AM

Optional Attachments
☐Siteplan
☒Site Coordinate Abbreviations
☐Other safeguard measures

Name and official title of owner/operator or authorized representative:	Date	Signature
		Jayshree Desai

Chemical Description	Physical and Health Hazards	Inventory	Storage Codes & Locations
CAS: 68476-34-6 Trade Secret: No Chem.Name: DIESEL FUEL #2 EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS	☒Fire ☐Pressure ☐Reactivity ☒Immediate ☒Delayed (Chronic)	06 Max Daily Amount Code 06 Ave. Daily Amount Code 365 No. of days on site	

Con. Type	Press.	Temp	Storage Location
B	1	4	TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC.
C	1	4	TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC.
A	1	4	TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC.
C	1	4	TANK FARM NEAR #5 WAREHOUSE; INSIDE DIESEL GENERATOR BLDGS; INSIDE SCREENHOUSE; ETC.

Chemical Description	Physical and Health Hazards	Inventory	Storage Codes & Locations
CAS: 10043-35-3 Trade Secret: No Chem.Name: BORIC ACID EHS Name: Check all that apply: ☒Pure ☒Mix ☒Solid ☒Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☒Delayed (Chronic)	05 Max Daily Amount Code 05 Ave. Daily Amount Code 365 No. of days on site	

Con. Type	Press.	Temp	Storage Location
C	1	4	AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE
J	1	4	AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE
C	1	4	AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE
C	1	4	AUXILLARY BLDG - CONTAINMENT BLDG - REFUELING POOL - LAUNDRY AREA - #8 WAREHOUSE

CAS: 1310-73-2
Trade Secret: No
Chem.Name: SODIUM HYDROXIDE 50%
EHS Name:
Check all that apply:
☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS

☐Fire
☐Pressure
☐Reactivity
☒Immediate
☒Delayed (Chronic)

05
Max Daily Amount Code
04
Ave. Daily Amount Code
365
No. of days on site

Con. Type	Press.	Temp	Storage Location
C	1	4	INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES
C	1	4	INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES
C	1	4	INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES
D	1	4	INSIDE AUXILLARY BLDG; INSIDE UNIT 1 AND 2 STANDPIPES

CAS: 302-01-2
Trade Secret: No
Chem.Name: HYDRAZINE 35%
EHS Name:
Check all that apply:
☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☒EHS

☐Fire
☐Pressure
☒Reactivity
☒Immediate
☒Delayed (Chronic)

03
Max Daily Amount Code
03
Ave. Daily Amount Code
365
No. of days on site

Con. Type	Press.	Temp	Storage Location
E	1	4	warehouse #2; outside cold chemical laboratory
E	1	4	warehouse #2; outside cold chemical laboratory

Chemical Description	Physical and Health Hazards	Inventory	Storage Codes & Locations
CAS: 7727-37-9 Trade Secret: No Chem.Name: NITROGEN, REFRIGERATED LIQUID EHS Name: Check all that apply: ☒Pure ☐Mix ☐Solid ☒Liquid ☒Gas ☐EHS	☐Fire ☒Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type / Press. / Temp / Storage Location L / 2 / 4 / EAST OF TURBINE BLDG A / 2 / 7 / EAST OF TURBINE BLDG
CAS: 7439-92-1 Trade Secret: No Chem.Name: LEAD AND LEAD COMPOUNDS EHS Name: Check all that apply: ☒Pure ☒Mix ☒Solid ☐Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☒Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type / Press. / Temp / Storage Location R / 1 / 4 / LEAD-ACID BATTERIES IN PLANT AND SUBSTATION
CAS: 7439-92-1 Trade Secret: No Chem.Name: OIL, LUBE EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS	☒Fire ☐Pressure ☐Reactivity ☐Immediate ☐Delayed (Chronic)	05 Max Daily Amount Code 05 Ave. Daily Amount Code 365 No. of days on site	Con. Type / Press. / Temp / Storage Location A / 1 / 4 / OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE C / 1 / 4 / OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE D / 1 / 4 / OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE R / 1 / 4 / OIL STORAGE ROOMS; TURBINE BLDG; DIESEL GENERATOR BLDGS; SCREENHOUSE

CAS: 7647-15-6 Trade Secret: No Chem.Name: NALCO 1318 LIQUID EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 03 Ave. Daily Amount Code 365 No. of days on site	

Con. Type	Press.	Temp	Storage Location
C	1	4	CHLORINE HOUSE

Chemical Description	Physical and Health Hazards	Inventory	Storage Codes & Locations
CAS: 7681529 Trade Secret: No Chem.Name: SODIUM HYPOCHLORITE SOLUTION EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type / Press. / Temp / Storage Location C / 1 / 4 / CHLORINE BUILDING C / 1 / 4 / CHLORINE BUILDING
CAS: 74-98-6 Trade Secret: No Chem.Name: PROPANE (LIQUIFIED PETROLEUM GAS) EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☒Gas ☐EHS	☒Fire ☒Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type / Press. / Temp / Storage Location A / 1 / 4 / WEST SIDE OF PLANT A / 1 / 4 / WEST SIDE OF PLANT A / 1 / 4 / WEST SIDE OF PLANT A / 1 / 4 / WEST SIDE OF PLANT
CAS: 107-21-1 Trade Secret: No Chem.Name: ETHYLENE GLYCOL EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☒Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type / Press. / Temp / Storage Location D / 1 / 4 / WAREHOUSE #3 - D5 & D6 BUILDING - COMPUTER ROOM CHILLER C / 1 / 4 / WAREHOUSE #3 - D5 & D6 BUILDING - COMPUTER ROOM CHILLER
CAS: 124-38-9 Trade Secret: No Chem.Name: CARBON DIOXIDE EHS Name: Check all that apply: ☒Pure ☐Mix ☐Solid ☒Liquid ☒Gas ☐EHS	☐Fire ☐Pressure ☒Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on	Con. Type / Press. / Temp / Storage Location L / 2 / 4 / TURBINE BLDG; GAS HOUSE-E SIDE OF PLANT C / 2 / 7 / TURBINE BLDG; GAS HOUSE-E SIDE OF PLANT

site

Chemical Description	Physical and Health Hazards	Inventory	Storage Codes & Locations
CAS: 80522-42-4 Trade Secret: No Chem.Name: PETROLEUM ASPHALT EHS Name: Check all that apply: ☐Pure ☒Mix ☐Solid ☒Liquid ☐Gas ☐EHS	☒Fire ☐Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 03 Ave. Daily Amount Code 090 No. of days on site	Con. Type: P; Press.: 1; Temp: 4; Storage Location: OUTDOORS
CAS: 69011183/ 69011207 Trade Secret: No Chem.Name: EPICOR ANION/CATION RESIN EHS Name: Check all that apply: ☐Pure ☐Mix ☒Solid ☐Liquid ☐Gas ☐EHS	☒Fire ☐Pressure ☐Reactivity ☒Immediate ☒Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type: C; Press.: 1; Temp: 4; Storage Location: WAREHOUSE #2; VARIOUS AREAS IN PLANT Con. Type: E; Press.: 1; Temp: 4; Storage Location: WAREHOUSE #2; VARIOUS AREAS IN PLANT
CAS: N/A Trade Secret: No Chem.Name: BLACK BEAUTY PRODUCTS EHS Name: Check all that apply: ☐Pure ☒Mix ☒Solid ☐Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 365 No. of days on site	Con. Type: J; Press.: 1; Temp: 4; Storage Location: PLANT
CAS: 7440-44-0 Trade Secret: No Chem.Name: COKE METALLERGICAL EHS Name: Check all that apply: ☐Pure ☒Mix ☒Solid ☐Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	04 Max Daily Amount Code 04 Ave. Daily Amount Code 014 No. of days on site	Con. Type: R; Press.: 1; Temp: 4; Storage Location: PLANT WELLS

Chemical Description	Physical and Health Hazards	Inventory	Storage Codes & Locations
CAS: 14808-60-7 Trade Secret: No Chem.Name: SPECTRUS DT1401 (DETOXIFYING AGENT) EHS Name: Check all that apply: ☐Pure ☒Mix ☒Solid ☐Liquid ☐Gas ☐EHS	☐Fire ☐Pressure ☐Reactivity ☒Immediate ☐Delayed (Chronic)	01 Max Daily Amount Code 01 Ave. Daily Amount Code 365 No. of days on site	Con. Type: J; Press.: 1; Temp: 4; Storage Location: AT THE SITE FOR ZEBRA MUSCLE TREATMENT

Print Set page to landscape before printing the page

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***

ERC ID#: 25-150-0001

Contact Person: Jeanne Tobias

Alternate Contact:

24 hr #: (651) 998-4251

Work Phone: (651) 998-4626

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Acetone	561		Warehouse #3 695' level truck isle	Barrels	55 Gallons	165 Gallons	110 Gallons	No
Alcohol	562		Warehouse #3 695' level truck isle	Barrels	55 Gallons	0 Gallons	0 Gallons	No
Alumina Dessicant	2522		Ware House #1. For air dryer	Drums	55 Gallons	110 Gallons	110 Gallons	No
Ammonium Hydroxide (28%)	1717		Outside Cold Lab. Not an EHS. Liquid is 7.5 lb/gal. Approx. 28% NH3.	Drums	55 Gallons	55 Gallons	25 Gallons	No
Ammonnium Hydroxide (15%)	2523		Warehouse #2. EHS 2 lb/gal	Drums	30 Gallons	30 Gallons	30 Gallons	No
Black Beauty Slag Products.	2279		Warehouse #3. Slag used for sand blasting.	Bags	50 Lbs	32,000 Lbs	20,000 Lbs	Yes
Boric Acid (0 - 2%)	553		Reactor coolant system	Flow Through Process Tank	14000 Lbs	14,000 Lbs	7,000 Lbs	Yes
Boric Acid (0 - 2%) Solid	550		Above Laundry area - 735' level, Cold Lab, warehouse #1, #3 and #8. Per Jeanne Tobias comments on 2/10/5 combined records 550 and	Bags	50 Lbs	38,000 Lbs	38,000 Lbs	Yes
Boric Acid (12%)	554	121	735' auxiliary bldg (boric acid batching tank)	Flow Through Process Tank	800 Gallons	800 Gallons	800 Gallons	Yes
Boric Acid (12%)	940	11	735' auxiliary building (boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (12%)	941	121	735' auxiliary building (boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (12%)	942	21	735' auxiliary building (boric acid storage tank)	Flow Through Process Tank	5000 Gallons	5000 Gallons	5000 Gallons	Yes
Boric Acid (6%)	552		Spent fuel pool and refueling storage tank	Other	50000 Lbs	50000 Lbs	50000 Lbs	Yes
Brine, R. O.	1965		Indoor, West of water treatment (flow trough process tank). No EHS. Assumed water density 8.4 lb/gal. Brine concentration in R. O. water 26%	AST	10000 Gallons	10,000 Gallons	10,000 Gallons	No

HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant*** *Contact Person: Jeanne Tobias* *Work Phone: (651) 998-4626*

Alternate Contact:

ERC ID#: 25-150-0001 *24 hr #: (651) 998-4251*

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Carbon Dioxide, Gas	1053		Gas house, of plant next to radwaste bldg	Cylinders	60 Lbs	3000 Lbs	3000 Lbs	Yes
Carbon Dioxide, Liquid	1052		Turbine bldg	Tank	12000 Lbs	12,000 Lbs	12,000 Lbs	Yes
Carbon Dioxide, Solid (Dry Ice)	2451		Used in March 2001 for dry ice blasting of # 124 cooling tower pump motor in Unit 2.	Other	Lbs	0 Lbs	0 Lbs	Yes
Coke, Metallurgical	2369		Bone Yard. Used in turbine bldg sumps to absorb oil. (Note: inventory should include installed coke + amt on-site in drums + amt on-site awaiting	Drums	Lbs	65,000 Lbs	30,000 Lbs	Yes
Diesel Fuel	2015		Tank farm, north of plant near #5 warehouse. Installed July '00. Replaced tank # 583.	AST	550 Gallons	500 Gallons	250 Gallons	Yes
Diesel Fuel	2256		On site Sept 2004 - October 2004, (Temp for Steam Generator Replacement)	AST	550 Gallons	0 Gallons	0 Gallons	Yes
Diesel Fuel #2	194		Inside guard house (day tank for security diesel)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	195	12	Inside screenhouse (#12 diesel cooling water pump day tank)	AST	580 Gallons	575 Gallons	575 Gallons	Yes
Diesel Fuel #2	196	22	Inside screenhouse (# 22 diesel cooling water pump day tank)	AST	580 Gallons	575 Gallons	575 Gallons	Yes
Diesel Fuel #2	197		Inside turbine bldg (D1 diesel generator fuel oil day tank)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	198		Inside turbine bldg (D2 diesel generator fuel oil day tank)	AST	500 Gallons	500 Gallons	500 Gallons	Yes
Diesel Fuel #2	199		Inside screenhouse (fire pump diesel oil day tank)	AST	280 Gallons	200 Gallons	200 Gallons	Yes
Diesel Fuel #2	200		Inside bldg. #3 (#3 diesel generator day tank)	AST	125 Gallons	125 Gallons	100 Gallons	Yes
Diesel Fuel #2	201		Inside bldg. #4 (#4 diesel generator day tank)	AST	125 Gallons	125 Gallons	100 Gallons	Yes

EPCRA SECTION 312 (TIER II)

EPA Reporting Year: 2005

HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant*** *Contact Person:* *Jeanne Tobias* *Work Phone:* *(651) 998-4626*

Alternate Contact:

ERC ID#: *25-150-0001* *24 hr #:* *(651) 998-4251*

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Diesel Fuel #2	210	21	Outside near SBO bldg. (fuel oil receiving tank)	AST	15000 Gallons	15000 Gallons	1000 Gallons	Yes
Diesel Fuel #2	211	21	Underground vault southwest side of SBO bldg. (D5 fuel oil storage tank)	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	212	22	Underground vault southwest side of SBO bldg. (D6 fuel oil storage tank)	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	213	23	Underground vault southwest side of SBO bldg. (D5 fuel oil storage tank)	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	214	24	Underground vault southwest side of SBO bldg. (D6 fuel oil storage tank)	AST	32778 Gallons	32778 Gallons	32700 Gallons	Yes
Diesel Fuel #2	218	21	Inside SBO bldg. (day tank for D5 diesel)	AST	665 Gallons	665 Gallons	640 Gallons	Yes
Diesel Fuel #2	219	22	Inside SBO building (day tank for D6 diesel)	AST	665 Gallons	665 Gallons	640 Gallons	Yes
Diesel Fuel #2	459	121	East of screenhouse (diesel fire pump oil storage tank)	UST	4000 Gallons	4000 Gallons	3000 Gallons	Yes
Diesel Fuel #2	460	124	East of service building (124 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	461	123	East of service building (123 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	462	122	East of service building (122 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	463	121	East of service building (121 diesel generator oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	464	122	East of turbine building (122 heating boiler oil storage tank)	UST	35000 Gallons	35000 Gallons	25000 Gallons	Yes
Diesel Fuel #2	465	121	East of turbine bldg. (121 heating boiler oil storage tank)	UST	35000 Gallons	35000 Gallons	35000 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant***

ERC ID#: 25-150-0001

Contact Person: Jeanne Tobias

Alternate Contact:

24 hr #: (651) 998-4251

Work Phone: (651) 998-4626

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Diesel Fuel #2	466	122	East of screenhouse (22 diesel cooling water pump oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Diesel Fuel #2	467	121	East of screenhouse (12 diesel cooling water pump oil storage tank)	UST	19500 Gallons	19500 Gallons	19500 Gallons	Yes
Ehylene Glycol (phosphate) Dowtherm SR-1Inhibitor	1334		Turbine Bldg 695'. Antifreeze supplemental coolant additive. No EHSs. Liquid is 12.8 lb/gal. Ethylene glycol = 8%.	Drums	55 Gallons	110 Gallons	75 Gallons	Yes
Ethylene Glycol (100%)	592		Warehouse #3. Not an EHS. 9.4 lb/gal	Barrels	55 Gallons	850 Gallons	550 Gallons	Yes
Ethylene Glycol (50%)	593		D5 & D6 building system	Other	5000 Gallons	4800 Gallons	4600 Gallons	Yes
Ethylene Glycol (50%)	594		3 Heating systems and computer room chiller	Other	1600 Gallons	3000 Gallons	1400 Gallons	Yes
Formaldehyde various grades (5%, 10% & 37%)	1740		Formaldehyde various grades at PI environmental Laboratory	Pails	5 Gallons	11 Gallons	10 Gallons	No
Freon 11	1048		Warehouse #2. Not an EHS	Barrels	90 Lbs	1800 Lbs	1800 Lbs	No
Freon 22	1050		Warehouse #2 (no EHSs) (9.9 lb/gal)	Cylinders	20 Lbs	100 Lbs	100 Lbs	No
Gasoline	2014		Tank farm north of plant, near #5 Warehouse. Installed July '00. Replaced tank # 209.	AST	550 Gallons	500 Gallons	250 Gallons	No
GE Betz MD 4106, Molybdate Corrosion Inhibitor	2914		Unit 2 Turbine Bldg. 715", warehouse #2, Whse #4	Drums	55 Gallons	385 Gallons	385 Gallons	No
GE Betz Spectrus NX 1105	2156		Chemistry Storage Room, Not EHS	Pails	5 Gallons	5 Gallons	5 Gallons	No
GE, Betz Spectrus 1106 (Isothiazolin)	1962		Chem storage room, warehouse #2, warehouse #4, no EHS, 11.62 lb/gal.	Pails	5 Gallons	10 Gallons	10 Gallons	No
Halon 1301	1046		Various fire suppression areas; various sizes	Cylinders	Lbs	3731 Lbs	3731 Lbs	No

EPCRA SECTION 312 (TIER II)
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ERC ID#: 25-150-0001

Contact Person: Jeanne Tobias

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24 hr #: (651) 998-4251

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Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Hydrazine (35%)	557		Warehouse #2.	Barrels	30 Gallons	300 Gallons	200 Gallons	Yes
Hydrazine (35%)	558	3	Outside cold lab. EHS. Liquid = 8.5 lb/gal, Unit 1 Turbine Bldg. 695'	Barrels	30 Gallons	300 Gallons	90 Gallons	Yes
Hydrochloric Acid	837		Chem storage, cold lab 695'; hot lab (exempt)	Glass Bottles	0.5 Gallons	4 Gallons	2 Gallons	No
Hydrogen, Gas	1054		Hydrogen gas house (1 lb / 194 ft3)	Cylinders	261 Cubic Feet	13050 Cubic Feet	13050 Cubic Feet	No
InstaCote ML-1-Stiff, Part A	1826		Unit 1 turbine bldg drop area. No EHSs, but TRI = MDI (unk %). 10.0 lb/gal. New in 2002.	Drums	55 Gallons	0 Gallons	0 Gallons	No
InstaCote ML-2 Soft Resin, Part B	2512		Unit 1 turbine bldg drop area. No EHSs or TRIs. 8.4 lb/gal. New in 2002.	Drums	55 Gallons	0 Gallons	0 Gallons	No
Kerosene	781		Warehouse #3. Not an EHS. 6.9 lb/gal	Pails	5 Gallons	50 Gallons	40 Gallons	No
Kerosene	1718		Warehouse #3, 6.9 lb/gal. Not an EHS.	Drums	55 Gallons	220 Gallons	110 Gallons	No
Lead & Lead Compounds in Lead-Acid Batteries	2065		Various areas (warehouse #5 and #8, Turbine and Service Bldg., battery room etc.) Approx. 10.6 lb of Pb/ lb of acid. 10.6 x 4360 lb of acid = 46,200	Battery	Lbs	46,200 Lbs	46,200 Lbs	Yes
Milsolv 3224 M. 190 Proof	2981		H20, denatured alcohol, Isopropanol etc.East Turbine Truck Aisle. density 6.78 lb/gal, no EHS.	Drums	55 Gallons	110 Gallons	55 Gallons	No
Nalco 1250, Carbohydrazide	1251		Warehouse #2 and whse #4; Cold Lab 695'. No EHSs. 8.7 lb/gal.	Barrels	55 Gallons	110 Gallons	55 Gallons	No
Nalco 1318, Sodium Bromide	967	121	Inside chlorine building. 12.2 lb/gal. NaBr = 40%. No EHSs. On 7/24/00 Nalco Acti-brom 1338 switched to Nalco 1318. Both have same	AST	1273 Gallons	1273 Gallons	500 Gallons	Yes
Nalco 1336 (Sodium Tolyltriazol)	2915		Chemistry Storage room.	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco 39M Corrosion Inhibitor, Nitrite Based	1433		Warehouse #2 and Chemistry Storage Room, No EHSs present. 9.5 lb/gal.	Pails	5 Gallons	55 Gallons	30 Gallons	No

HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant*** *Contact Person:* *Jeanne Tobias* *Work Phone:* *(651) 998-4626*

ERC ID#: *25-150-0001* *Alternate Contact:*

24 hr #: *(651) 998-4251*

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Nalco 7338 (Biocide)	833		Warehouse #2. No EHSs (9.3 lb/gal)	Pails	5 Gallons	0 Gallons	0 Gallons	No
Nalco 8103 Coagulant	2917		9.1 lbs/gal, No EHS, Chem Storage Room	Pails	5 Gallons	10 Gallons	5 Gallons	No
Nalco 8320 (300 ppm Sodium Chromate)	2016		This tank is actualy a "holding" tank for when maintenance is performed on the emergency diesel. No EHSs present. Approx. 8.3 lb/gal This	AST	500 Gallons	500 Gallons	150 Gallons	No
Nalco 8320, Sodium Chromate	910		Warehouse #3. Pure prodct. No EHSs. 14.2 lb/gal.	Drums	30 Gallons	30 Gallons	30 Gallons	No
Nalco 8338 (Nitrite Based corrosion Inhibitor)	2916		Chemistry Storage room, Warehouse #2	Pails	5 Gallons	15 Gallons	15 Gallons	No
Nalco Pre-tect 2040 HP, MPA	1044		Warehouse #2 and #4, cold lab 695'. No EHSs present. 8.1 lb/gal.	Drums	55 Gallons	440 Gallons	110 Gallons	No
Nitrogen, Liquid	555		Outside, E of turbine building. Not an EHS. (6.7 lb/gal)	Tank	1500 Gallons	1500 Gallons	1500 Gallons	Yes
Nitrogen, Liquid	556		East of turbine building.	Tank	1500 Gallons	1500 Gallons	1500 Gallons	Yes
Oil, Delvac 1330	2967		Turbin Bldg Unit 1 Oil Room. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Diesel Lube	572		Screenhouse (#12 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	110 Gallons	100 Gallons	Yes
Oil, Diesel Lube	573		Screenhouse (#22 diesel cooling water pump crankcase)	Flow Through Process Tank	110 Gallons	110 Gallons	100 Gallons	Yes
Oil, Diesel Lube	576		Turbine building (D1 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	577		Turbine building (D2 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, Diesel Lube	579		D3 building south of reactor (D3 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant*** *Contact Person:* *Jeanne Tobias* *Work Phone:* *(651) 998-4626*

ERC ID#: *25-150-0001* *Alternate Contact:*

24 hr #: *(651) 998-4251*

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Oil, Diesel Lube	580		D4 building south of reactor (D4 diesel generator crankcase)	Flow Through Process Tank	250 Gallons	250 Gallons	150 Gallons	Yes
Oil, DTE 24	2966		Oil Room in Turbine Unit 1 building 695'. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil BB SAE 40	2957		Oil Room in the Turbine Blg unit 1 695'. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Extra Heavy SAE 30	2960		Oil Roomin turbine blg unit 1 695'. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Heavy	2961		Oil Room in Turbine blg unit 1 695'. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Light SAE10	2964		Oil Room in Turbine Unit1 blg. 695'. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE Oil Medium	2963		Oil Room in Turbine Bld Unit1. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, DTE25	2968		Oil Room in Turbine Blg 695'. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Duragard Super HD 15W-40	2956		Oil Room in Turbine Blg Unit1 695'	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Fryquel EHC Hydraulic Fluid	1336		Warehouse #2. Not an EHS. (9.5 lb/gal)	Drums	55 Gallons	110 Gallons	55 Gallons	Yes
Oil, Fryquel EHC Hydraulic Fluid	1337		Turbine Bldg 715'.	Tank	55 Gallons	200 Gallons	200 Gallons	Yes
Oil, Lube	220		SBO building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	850 Gallons	800 Gallons	Yes
Oil, Lube	221	22	Inside SBO building (lube oil storage tank). Actual product is Shell Rotella T Multilube Oil: 7.3 lb/gal and no EHSs or reportable TRIs.	AST	850 Gallons	850 Gallons	800 Gallons	Yes
Oil, Mobil Gear 629	2958		Oil Room-oil is filtered and Turbine Bldg. Unit 1 695'.	AST	100 Gallons	100 Gallons	55 Gallons	Yes

EPCRA SECTION 312 (TIER II)
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ERC ID#: *25-150-0001* *Alternate Contact:*

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Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Oil, Mobil Rarus 827	2965		Oil Room in Turbine Unit 1 blg. 695' Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC-525	2970		Oil Storage Room in Turbine Blg Unit 1 695'. Oil is filtered	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobil SHC-632	2969		Oil Storage Room in Turbine Building 695'. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobile SHC-630	2955		Oil Room in Turbine Blg 695'. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Mobilgard 450	2959		Oil Room Turbine Blg unit 1 695'. Oil is filtered.	AST	100 Gallons	100 Gallons	55 Gallons	Yes
Oil, Transformer (Caltran 60-30)	2722		3 tankers on-site Nov 2002. No EHSs or TRIs present. 7.5 lb/gal. Product was placed in #1GT after old oil was removed. Product (old and new)	Tanker	5700 Gallons	0 Gallons	0 Gallons	No
Oil, Turbine Lube	584	121	Oil storage room (turbine oil storage tank)	AST	14000 Gallons	14000 Gallons	10000 Gallons	Yes
Oil, Turbine Lube	585		Oil storage room - 121 turbine oil makeup tank	AST	2000 Gallons	2000 Gallons	1500 Gallons	Yes
Oil, Turbine Lube	586	11	Turbine building (#1 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	14000 Gallons	13000 Gallons	Yes
Oil, Turbine Lube	587	21	Turbine building (#2 turbine generator oil sump/reservoir)	Flow Through Process Tank	14000 Gallons	14000 Gallons	13000 Gallons	Yes
Oil, Used	202	121	Outside west of plant (waste oil tank).	AST	5000 Gallons	3500 Gallons	1500 Gallons	Yes
Oil, Used	203	122	Outside west of plant (waste oil tank).	AST	5000 Gallons	3500 Gallons	1500 Gallons	Yes
Oil, Used	217		Inside turbine bldg oil rm.	AST	250 Gallons	250 Gallons	150 Gallons	Yes
Oxygen, Liquid	1056		Turbine bldg	Dewars	25 Gallons	50 Gallons	35 Gallons	No

EPCRA SECTION 312 (TIER II)
HAZARDOUS SUBSTANCE INVENTORY REPORT

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ERC ID#: *25-150-0001*	*Alternate Contact:*	
	24 hr #: *(651) 998-4251*	

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Petroleum Asphalt (Roofing Tar)	1214		Tanker Truck, parking lot. NPD Vault, Env Lab, De-Icing House, OAB, Plant Screen House, Int Screen House. Sp. Gr. 0.9	Tanker	4000 Gallons	3000 Gallons	2000 Gallons	Yes
Propane	588		West of plant	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	589		West of plant. Used for NPD heat. No EHSs present. 4.2 lb/gal.	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	590		West of plant, Used for NPD Bldg. heat.	Tank	1000 Gallons	900 Gallons	800 Gallons	Yes
Propane	1657		Met tower bldg	Tank	250 Gallons	250 Gallons	250 Gallons	Yes
Resin, Clinophthilonite	2520		Warehouse #2 and warehouse #4 No EHSs preset.	Drums	55 Gallons	220 Gallons	220 Gallons	No
Resins, Demineralizer	1327		Various Locations (installed and in stock). Includes: Epicor anion, cation and mixed bed resins. No EHSs. 10.0 lb/gal	Fiber Drums & Flow Thru Process Tanks	Lbs	37000 Lbs	37000 Lbs	Yes
Resins, Lithium Hydroxide (Mixed Bed)	2275		Warehouse # 2 and warehouse #4. (50 L drums)	Drums	140 Lbs	4200 Lbs	2100 Lbs	No
Salt (Sodium Chloride)	2296		Training center and various plant areas and turbine bldg. No EHSs present.	Bags	50 Lbs	2000 Lbs	2000 Lbs	No
Sodium Bisulfate	1743		Warehouse #4. Not an EHS.Water Treatment Cleaning	Drums	100 Lbs	100 Lbs	100 Lbs	No
Sodium Carbonate	1742		Warehouse #2.	Pails	50 Lbs	50 Lbs	50 Lbs	No
Sodium Hydroxide (10%)	206	11	Inside auxiliary bldg (caustic standpipe - unit 1). Not an EHS. Approx. 8.3 lb/gal.	AST	2700 Gallons	2700 Gallons	2600 Gallons	Yes
Sodium Hydroxide (10%)	207	21	Inside auxiliary bldg (caustic standpipe - unit 2)	AST	2700 Gallons	2700 Gallons	2600 Gallons	Yes
Sodium Hydroxide (10%)	2274		Warehouse #2. Received on 4/00.	Drums	55 Gallons	55 Gallons	55 Gallons	Yes

HAZARDOUS SUBSTANCE INVENTORY REPORT

Plant: ***Prairie Island Generating Plant*** *Contact Person: Jeanne Tobias* *Work Phone: (651) 998-4626*

Alternate Contact:

ERC ID#: 25-150-0001 *24 hr #: (651) 998-4251*

Substance	Xcel Record #	Site Tank #	Storage Location	Storage Method	Container Capacity	Maximum Amount On-Site	Average Amount On-Site	Reportable in 2005?
Sodium Hypochlorite (15%)	215	121	Inside chlorine bldg (bulk sodium hypochlorite tank) No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	1273 Gallons	600 Gallons	Yes
Sodium Hypochlorite (15%)	966	122	Inside chlorine building (bulk sodium hypochlorite tank). No EHSs. Liquid is 10.0 lb/gal.	AST	1273 Gallons	1273 Gallons	600 Gallons	Yes
Sodium Sulfite	1332		Outside Cold Lab. Not EHS or TRI. 21.6 lb/gal. Bleach used for spill clean-up.	Bags	100 Lbs	100 Lbs	100 Lbs	No
Spectrus CT1300 (Biocide)	2359		Used for April 2004 zebra mussel treatment. No EHSs or TRIs present. 8.0 lb/gal.(tote,drums and pails).	Tote Tank	300 Gallons	0 Gallons	0 Gallons	No
Spectrus DT1401 (Detoxifying Agent)	2604		Used for Apr 2004 zebra mussel treatment. Bennonite Clay. No EHSs or TRIs present.	Bags	100 Lbs	0 Lbs	0 Lbs	Yes
Stoddard Solvent	563		Warehouse #3, 695' level, truck isle. No EHS. 6.5 lb/gal	Barrels	55 Gallons	275 Gallons	165 Gallons	No
Sulfur Hexaflouride	841		Substation bldg. Several small cylinders. Not an EHS.	Cylinders	480 Lbs	480 Lbs	360 Lbs	No
Sulfuric Acid in Lead Acid Batteries	1744		Various locations in plant, forklifts and substation. Total = approx. 4360 lb.	Battery	Lbs	4360 Lbs	4360 Lbs	Yes
Zep Dyna 143	1655		Warehouse #2 and in two parts washers. Installed late in 1998. 6.5 lb/gal. No EHSs.	Drums	30 Gallons	220 Gallons	110 Gallons	No

This report was used as the basis for your facility's EPCRA Section 312 hazardous substance inventory (TIER II) submittal in 2006. Please keep this report in your EPCRA 312 file for at least 5 years. If there are any questions, contact Bruce Denney in ERAD at 612-337-2085.

AIR EMISSION PERMIT NO. 04900030-003

IS ISSUED TO

Northern States Power Company dba Xcel Energy

XCEL ENERGY – PRAIRIE ISLAND NUCLEAR
1717 Wakonade Drive East
Welch, Goodhue County, MN 55089

The emission units, control equipment and emission stacks at the stationary source authorized in this permit are as described in the following permit application(s):

Permit Type	Application Date	Issue Date	Action #
Total Facility Operating Permit	September 15, 1995	June 22, 2000	001
Major Amendment	November 13, 2002	June 3, 2003	002
Major Amendment	February 14, 2006	See Below	003
Total Facility Operating Permit – Reissuance	December 20, 2004		

This permit authorizes the Permittee to operate the stationary source at the address listed above unless otherwise noted in Table A. The Permittee must comply with all the conditions of the permit. Any changes or modifications to the stationary source must be performed in compliance with Minn. R. 7007.1150 to 7007.1500. Terms used in the permit are as defined in the state air pollution control rules unless the term is explicitly defined in the permit.

Permit Type: Federal; Pt 70/Limits to Avoid NSR

Issue Date: January 3, 2007

Expiration: January 3, 2012
Title I Conditions do not expire.

Richard J. Sandberg, Manager
Air Quality Permits Section
Industrial Division

for Brad Moore
Commissioner
Minnesota Pollution Control Agency

TABLE OF CONTENTS

NOTICE TO THE PERMITTEE:

Your stationary source may be subject to the requirements of the Minnesota Pollution Control Agency's (MPCA) solid waste, hazardous waste, and water quality programs. If you wish to obtain information on these programs, including information on obtaining any required permits, please contact the MPCA general information number at:

Metro Area	651-296-6300
Outside Metro Area	1-800-657-3864
TTY	651-282-5332

The rules governing these programs are contained in Minn. R. chs. 7000-7105. Written questions may be sent to: Minnesota Pollution Control Agency, 520 Lafayette Road North, St. Paul, Minnesota 55155-4194.

Questions about this air emission permit or about air quality requirements can also be directed to the telephone numbers and address listed above.

PERMIT SHIELD:

Subject to the limitations in Minn. R. 7007.1800, compliance with the conditions of this permit shall be deemed compliance with the specific provision of the applicable requirement identified in the permit as the basis of each condition. Subject to the limitations of Minn. R. 7007.1800 and 7017.0100, subp. 2, notwithstanding the conditions of this permit specifying compliance practices for applicable requirements, any person (including the Permittee) may also use other credible evidence to establish compliance or noncompliance with applicable requirements.

FACILITY DESCRIPTION:

This air emission facility is part of the Northern States Power Prairie Island Nuclear Generating Plant. The air emission facility is composed of an oil-fired heating boiler and 12 diesel-fired engines that are used to either generate emergency power, pump cooling water, or pump water for fire fighting.

PERMIT ACTION 003 DESCRIPTION:

This is a reissuance of a Part 70 operating permit that includes changes applied for as a major amendment. The major amendment is to increase the NO_x limit for each diesel engine from 3.35 to 4.0 lbs/mmBTU heat input to allow for some cushion for stack testing the larger diesel engines. As a result, the fuel usage limit will be decreased from 83955 to 70238 gallons/month. This is a Title I Condition emission limit to restrict facility NO_x potential emissions to less than the major source level of 250 tons/year. No emission changes are allowed by this permitting action.

TABLE A: LIMITS AND OTHER REQUIREMENTS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

Table A contains limits and other requirements with which your facility must comply. The limits are located in the first column of the table (What To do). The limits can be emission limits or operational limits. This column also contains the actions that you must take and the records you must keep to show that you are complying with the limits. The second column of Table A (Why to do it) lists the regulatory basis for these limits. Appendices included as conditions of your permit are listed in Table A under total facility requirements.

Subject Item: **Total Facility**

What to do	Why to do it
OPERATIONAL REQUIREMENTS	hdr
The Permittee shall comply with National Primary and Secondary Ambient Air Quality Standards, 40 CFR pt. 50, and the Minnesota Ambient Air Quality Standards, Minn. R. 7009.0010 to 7009.0080. Compliance shall be demonstrated upon written request by the MPCA.	40 CFR pt. 50; Minn. Stat. Sec. 116.07, subds. 4a & 9; Minn. R. 7007.0100, subps. 7A, 7L & 7M; Minn. R. 7007.0800, subps. 1, 2, & 4; Minn. R. 7009.0010 - 7009.0080
Circumvention: Do not install or use a device or means that conceals or dilutes emissions, which would otherwise violate a federal or state air pollution control rule, without reducing the total amount of pollutant emitted.	Minn. R. 7011.0020
Operation Changes: In any shutdown, breakdown, or deviation the Permittee shall immediately take all practical steps to modify operations to reduce the emission of any regulated air pollutant. The Commissioner may require feasible and practical modifications in the operation to reduce emissions of air pollutants. No emissions units that have an unreasonable shutdown or breakdown frequency of process or control equipment shall be permitted to operate.	Minn. R. 7019.1000, subp. 4
Fugitive Emissions: Do not cause or permit the handling, use, transporting, or storage of any material in a manner which may allow avoidable amounts of particulate matter to become airborne. Comply with all other requirements listed in Minn. R. 7011.0150.	Minn. R. 7011.0150
Noise: The Permittee shall comply with the noise standards set forth in Minn. R. 7030.0010 to 7030.0080 at all times during the operation of any emission units. *This is a state only requirement and is not enforceable by the EPA Administrator or citizens under the Clean Air Act.*	Minn. R. 7030.0010 - 7030.0080
Inspections: The Permittee shall comply with the inspection procedures and requirements as found in Minn. R. 7007.0800, subp. 9(A).	Minn. R. 7007.0800, subp. 9(A)
The Permittee shall comply with the General Conditions listed in Minn. R. 7007.0800, subp. 16.	Minn. R. 7007.0800, subp. 16
PERFORMANCE TESTING	hdr
Performance Testing: Conduct all performance tests in accordance with Minn. R. ch. 7017.	Minn. R. ch. 7017
Performance Test Notifications and Submittals: Performance Test Notification (written): due 30 days before each Performance Test Performance Test Plan: due 30 days before each Performance Test Performance Test Pre-test Meeting: due 7 days before each Performance Test Performance Test Report: due 45 days after each Performance Test Performance Test Report - Microfiche: due 105 days after each Performance Test The Notification, Test Plan, and Test Report may be submitted in alternative format as allowed by Minn. R. 7017.2018.	Minn. R. 7017.2018; Minn. R. 7017.2030, subps. 1-4; Minn. R. 7017.2035, subps. 1-2
Limits set as a result of a performance test (conducted before or after permit issuance) apply until superseded as specified by Minn. R. 7017.2025 following formal review of a subsequent performance test on the same unit and completion of permit reopening and reissuance. If limits serve to cause more stringent operating conditions, resulting changes to facility operation need to be made immediately. If limits serve to relax current operating conditions, resulting changes to facility operation must not be made prior to issuance of permit amendment with new limit incorporated.	Minn. R. 7017.2025
MONITORING REQUIREMENTS	hdr
Monitoring Equipment Calibration: Annually calibrate all required monitoring equipment.	Minn. R. 7007.0800, subp. 4(D)
Operation of Monitoring Equipment: Monitoring a process or control equipment connected to that process is not necessary during periods when the process is shutdown, or during checks of the monitoring systems, such as calibration checks and zero and span adjustments. If monitoring records are required, they should reflect any such periods of process shutdown or checks of the monitoring system.	Minn. R. 7007.0800, subp. 4(D)
RECORDKEEPING	hdr

TABLE A: LIMITS AND OTHER REQUIREMENTS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

Recordkeeping: Retain all records at the stationary source for a period of five (5) years from the date of monitoring, sample, measurement, or report. Records which must be retained at this location include all calibration and maintenance records, all original recordings for continuous monitoring instrumentation, and copies of all reports required by the permit. Records must conform to the requirements listed in Minn. R. 7007.0800, subp. 5(A).	Minn. R. 7007.0800, subp. 5(C)
Recordkeeping: Maintain records describing any insignificant modifications (as required by Minn. R. 7007. 1250, subp. 3) or changes contravening permit terms (as required by Minn. R. 7007.1350 subp. 2), including records of the emissions resulting from those changes.	Minn. R. 7007.0800, subp. 5(B)
REPORTING/SUBMITTALS	hdr
Shutdown Notifications: Notify the Commissioner at least 24 hours in advance of a planned shutdown of any control equipment or process equipment if the shutdown would cause any increase in the emissions of any regulated air pollutant. If the owner or operator does not have advance knowledge of the shutdown, notification shall be made to the Commissioner as soon as possible after the shutdown. However, notification is not required in the circumstances outlined in Items A, B and C of Minn. R. 7019.1000, subp. 3. At the time of notification, the owner or operator shall inform the Commissioner of the cause of the shutdown and the estimated duration. The owner or operator shall notify the Commissioner when the shutdown is over.	Minn. R. 7019.1000, subp. 3
Breakdown Notifications: Notify the Commissioner within 24 hours of a breakdown of more than one hour duration of any control equipment or process equipment if the breakdown causes any increase in the emissions of any regulated air pollutant. The 24-hour time period starts when the breakdown was discovered or reasonably should have been discovered by the owner or operator. However, notification is not required in the circumstances outlined in Items A, B and C of Minn. R. 7019.1000, subp. 2. At the time of notification or as soon as possible thereafter, the owner or operator shall inform the Commissioner of the cause of the breakdown and the estimated duration. The owner or operator shall notify the Commissioner when the breakdown is over.	Minn. R. 7019.1000, subp. 2
Notification of Deviations Endangering Human Health or the Environment: As soon as possible after discovery, notify the Commissioner or the state duty officer, either orally or by facsimile, of any deviation from permit conditions which could endanger human health or the environment.	Minn. R. 7019.1000, subp. 1
Notification of Deviations Endangering Human Health or the Environment Report: Within 2 working days of discovery, notify the Commissioner in writing of any deviation from permit conditions which could endanger human health or the environment. Include the following information in this written description: 1. The cause of the deviation; 2. The exact dates of the period of the deviation, if the deviation has been corrected; 3. Whether or not the deviation has been corrected; 4. The anticipated time by which the deviation is expected to be corrected, if not yet corrected; and 5. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the deviation.	Minn. R. 7019.1000, subp. 1
Application for Permit Amendment: If a permit amendment is needed, submit an application in accordance with the requirements of Minn. R. 7007.1150 through Minn. R. 7007.1500. Submittal dates vary, depending on the type of amendment needed.	Minn. R. 7007.1150 - 7007.1500
Extension Requests: The Permittee may apply for an Administrative Amendment to extend a deadline in a permit by no more than 120 days, provided the proposed deadline extension meets the requirements of Minn. R. 7007.1400, subp. 1(H).	Minn. R. 7007.1400, subp. 1(H)
Emission Inventory Report: due on or before April 1 of each calendar year following permit issuance. To be submitted on a form approved by the Commissioner.	Minn. R. 7019.3000 - 7019.3010
Emission Fees: due 60 days after receipt of an MPCA bill.	Minn. R. 7002.0005 - 7002.0095

TABLE A: LIMITS AND OTHER REQUIREMENTS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

Subject Item: **GP 001 Internal Combustion Engines**

Associated Items: EU 002 Diesel Engine D1

EU 003 Diesel Engine D2

EU 004 Diesel Cooling Water Pump 12

EU 005 Diesel Cooling Water Pump 22

EU 006 Diesel Fire Pump 121

EU 007 Diesel Engine D3

EU 008 Diesel Engine D4

EU 009 Security Diesel Engine

EU 010 Diesel Engine D5-1

EU 011 Diesel Engine D5-2

EU 012 Diesel Engine D6-1

EU 013 Diesel Engine D6-2

EU 014 Temporary Diesel Engine(s) >600 Hp

EU 015 Temporary Diesel Engine(s) <600 Hp

What to do	Why to do it
LIMITS AND OPERATING RESTRICTIONS	hdr
Fuel Usage: less than or equal to 70238 gallons/month using 12-month Rolling Average for GP 001	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000
Nitrogen Oxides: less than or equal to 4.0 lbs/million Btu heat input for each emission unit in GP 001	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000
Opacity: less than or equal to 20 percent opacity once operating temperature has been attained. This applies individually to each emission unit in GP 001.	Minn. R. 7011.2300, subp. 1
Sulfur Dioxide: less than or equal to 0.5 lbs/million Btu heat input (equivalent to a fuel oil sulfur content of 0.49 percent by weight). This applies individually to each emission unit in GP 001.	Minn. R. 7011.2300, subp. 2
Permitted Fuel: Distillate Fuel Oil with a maximum sulfur content of 0.49 percent by weight	Minn. R. 7007.0800, subp. 2
EU 014 and EU 015 Temporary Diesel Engines: The Permittee may operate temporary diesel fuel-fired engines at the facility providing the Permittee follows the fuel usage recordkeeping requirements and meets all applicable emission limits and fuel requirements in this subject item. A temporary engine is any engine that is not located and/or operated at the facility for more than twelve consecutive months, and does not include emission units 002, 003, 004, 005, 006, 007, 008, 009, 010, 011, 012, or 013.	Minn. R. 7007.0800, subp. 2
MONITORING AND RECORDKEEPING	hdr
Recordkeeping - EU 004 and EU 005 Operating Hours: by the last day of each month, the Permittee shall separately record EU 004 and EU 005 operating hours for the previous month, and separately record cumulative operating hours for EU 004 and EU 005 during the current calendar year.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.0800, subps. 4 & 5; Minn. R. 7007.3000;
DEFINITION OF "TOTAL GP 001 MONTHLY FUEL USAGE" "Total GP 001 Monthly Fuel Usage" is the monthly GP 001 fuel usage excluding EU 015 fuel usage when GP 001 (excluding EU 015) fuel usage is less than 60,000 gallons during the month. When GP 001 (excluding EU 015) fuel usage is equal or greater than 60,000 gallons, "TOTAL GP 001 MONTHLY FUEL USAGE" includes EU 015 fuel usage starting the month after the calculated GP 001 (excluding EU 015) monthly fuel usage exceeds 60,000 gallons, and each month thereafter until GP 001 monthly fuel usage (excluding EU 015) drops below 60,000 gallons.	Minn. R. 7007.0800, subp. 2

TABLE A: LIMITS AND OTHER REQUIREMENTS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

Fuel Usage Monitoring and Recordkeeping - by the last day of each month, calculate and record: 1. The Total GP 001 Monthly Fuel Usage for the previous month, and 2. The GP 001 12-month rolling average fuel usage for the previous 12-months Refer to the "Total GP 001 Monthly Fuel Usage" definition above.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.0800, subps. 4 & 5; Minn. R. 7007.3000;
Fuel Supplier Certification: The Permittee shall maintain certification from the fuel supplier that guarantees a maximum sulfur content in all fuel oil deliveries. The supplier will notify the Permittee in writing on the date of delivery of fuel oil with a sulfur content exceeding the guaranteed maximum.	Minn. R. 7007.0800, subps. 4 & 5
PERFORMANCE TESTING - EU 002/EU 003	hdr
Performance Test: due before end of each calendar 60 months starting 10/09/2006 to measure NOx emissions from EU 002 or EU 003. Testing shall commence with EU 002, and subsequently alternate between EU 002 and EU 003 at intervals not to exceed 60 months.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000; Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
Performance Test: due before end of each calendar 36 months starting 06/01/2004 to measure opacity emissions from EU 002 or EU 003. Testing shall commence with EU 002 and subsequently alternate between EU 002 and EU 003 at intervals not to exceed 36 months.	Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
PERFORMANCE TESTING - EU 004/EU 005	hdr
Initial Performance Test: due 90 days after Notification of resuming operation of either EU 004 or EU 005 for more than 100 hours in any calendar year. This performance test shall measure NOx emissions from EU 004 or EU 005.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000; Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
Initial Performance Test: due 90 days after Notification of resuming operation of either EU 004 or EU 005 for more than 100 hours in any calendar year. This performance test shall measure opacity emissions from EU 004 or EU 005.	Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
PERFORMANCE TESTING - EU 007/EU 008	hdr
Performance Test: due before end of each calendar 60 months starting 08/12/2005 to measure NOx emissions from EU 007 or EU 008. Testing shall commence with EU 008, and subsequently alternate between EU 007 and EU 008 at intervals not to exceed 60 months.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000; Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
Performance Test: due before end of each calendar 60 months starting 08/12/2005 to measure opacity emissions from EU 007 or EU 008. Testing shall commence with EU 008, and subsequently alternate between EU 007 and EU 008 at intervals not to exceed 60 months.	Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
PERFORMANCE TESTING - EU 010 & EU 011/EU 012 & EU 013	hdr
Performance Test: due before end of each calendar 60 months starting 08/15/2005 to measure NOx emissions from an emission unit pair (EU 010 & 011 or EU 012 & 013) that has not been tested in the previous five years. Testing shall commence with EU 010 & 011 and subsequently alternate between EU 010 & 011 and EU 012 & 013 at intervals not to exceed 60 months.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000; Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4
Performance Test: due before end of each calendar 60 months starting 08/15/2005 to measure opacity emissions from an emission unit pair (EU 010 & 011 or EU 012 & 013) that has not been tested in the previous five years. Testing shall commence with EU 010 & 011 and subsequently alternate between EU 010 & 011 and EU 012 & 013 at intervals not to exceed 60 months.	Minn. R. 7017.2020, subp. 1; Minn. R. 7017.2030, subp. 4

TABLE A: LIMITS AND OTHER REQUIREMENTS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

Subject Item: **EU 001 Boiler 1**

Associated Items: SV 001 Boiler 1

What to do	Why to do it
LIMITS AND OPERATING RESTRICTIONS	hdr
Fuel Usage: less than or equal to 31002 gallons/month using 12-month Rolling Average	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000
Nitrogen Oxides: less than or equal to 0.144 lbs/million Btu heat input	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.3000
Total Particulate Matter: less than or equal to 0.6 lbs/million Btu heat input	Minn. R. 7011.0510, subp. 1
Opacity: less than or equal to 20 percent opacity except for one six-minute period per hour of not more than 60 percent opacity	Minn. R. 7011.0510, subp. 2
Permitted Fuel: Distillate Fuel Oil with a maximum sulfur content of 0.49 percent by weight	Minn. R. 7007.0800, subp. 2
A temporary boiler may be brought onsite for a period of up to one year, for the purpose of providing steam, heat, or electric power in place of EU 001, when EU 001 is out of operation. The temporary boiler may not be operated at the same time as EU 001 except for up to eight hours during start-up and shutdown transition periods. The temporary boiler must have potential emission rates in lbs/hour for all criteria pollutants that are less than the permit emission limits and potential emission rates of EU 001. All fuel usage by any temporary boiler shall be included in the fuel usage recordkeeping required under this subject item.	Minn. R. 7007.0800, subp. 2
RECORDKEEPING	hdr
Fuel Usage Monitoring and Recordkeeping - by the last day of each month, calculate and record: 1. The total EU 001 fuel usage for the previous month, 2. The EU 001 12-month rolling average fuel usage for the previous 12-months. Any temporary boiler fuel usage shall be included in this fuel usage recordkeeping.	Title I Condition: To avoid classification as a major source under 40 CFR Section 52.21; Minn. R. 7007.0800, subp. 5; Minn. R. 7007.3000

TABLE B: SUBMITTALS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

Table B lists most of the submittals required by this permit. Please note that some submittal requirements may appear in Table A or, if applicable, within a compliance schedule located in Table C. Table B is divided into two sections in order to separately list one-time only and recurrent submittal requirements.

Each submittal must be postmarked or received by the date specified in the applicable Table. Those submittals required by parts 7007.0100 to 7007.1850 must be certified by a responsible official, defined in Minn. R. 7007.0100, subp. 21. Other submittals shall be certified as appropriate if certification is required by an applicable rule or permit condition.

Send any application for a permit or permit amendment to:

AQ Permit Technical Advisor
Industrial Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Also, where required by an applicable rule or permit condition, send to the Permit Technical Advisor notices of:
- accumulated insignificant activities,
- installation of control equipment,
- replacement of an emissions unit, and
- changes that contravene a permit term.

Unless another person is identified in the applicable Table, send all other submittals to:

AQ Compliance Tracking Coordinator
Industrial Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Send submittals that are required to be submitted to the U.S. EPA regional office to:

Mr. George Czerniak
Air and Radiation Branch
EPA Region V
77 West Jackson Boulevard
Chicago, Illinois 60604

Send submittals that are required by the Acid Rain Program to:

U.S. Environmental Protection Agency
Clean Air Markets Division
1200 Pennsylvania Avenue NW (6204N)
Washington, D.C. 20460

TABLE B: ONE TIME SUBMITTALS OR NOTIFICATIONS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

What to send	When to send	Portion of Facility Affected
Application for Permit Reissuance	*due 180 days before expiration of Existing Permit*	*Total Facility*
Notification	due 30 days after Resuming Operation by either EU 004 or EU 005 for more than 100 hours in any calendar year. This shall be a written notification indicating that the emission unit has exceeded 100 operating hours in the calendar year.	GP001
Testing Frequency Plan	due 60 days after Initial Performance Test to measure NOx emissions and opacity from EU 004 and EU 005. The plan shall specify a NOx and opacity testing frequency for EU 004 and EU 005 using the test data and MPCA guidance. Future performance tests on year (12-month), 36-month, and 60-month intervals, or as applicable, shall be required on written approval of MPCA per Minn. R. 7017.2020, subp. 1. The Plan may propose that future performance tests commence with testing of the emission unit that was not tested during the initial performance test, and that testing alternate between EU 004 and EU 005.	GP001

TABLE B: RECURRENT SUBMITTALS

Facility Name: Xcel Energy - Prairie Island Nuclear

Permit Number: 04900030 - 003

What to send	When to send	Portion of Facility Affected
Semiannual Deviations Report	due 30 days after end of each calendar half-year starting 06/22/2000. The first semiannual report submitted by the Permittee shall cover the calendar half-year in which the permit is issued. The first report of each calendar year covers January 1 - June 30. The second report of each calendar year covers July 1 - December 31. If no deviations have occured, the Permittee shall submit the report stating no deviations.	Total Facility
Compliance Certification	due 31 days after end of each calendar year starting 06/22/2000 (for the previous calendar year). The Certification shall be submitted on a form approved by the Commissioner, both to the Commissioner and to the U.S. EPA regional office in Chicago. This report covers all deviations experienced during the calendar year.	Total Facility

APPENDIX B
Insignificant Activities and Applicable Requirements
Facility Name: Xcel Energy – Prairie Island Nuclear Generating Plant
Permit Number: 04900030-003

Under Minn. R. 7007.1250, subp. 1(A), the Permittee may add insignificant activities to the stationary source throughout the term of the permit without getting permit amendments. Certain exclusions apply and are listed in Minn. R. 7007.1250, subp. 2.

The following sources at the Permittee's facility qualify as insignificant activities under Minn. R. 7007.1300, subps. 3 and 4 and are not required to be listed in the permit.

Minn. R. 7007.1300, subp.	Rule Description of the Activity	General Applicable Requirement
3(A)	Space heaters fueled by kerosene, natural gas, or propane	Minn. R. 7011.0515
3(G)	Emissions from laboratories	Minn. R. 7011.0515
3(H)(3)	Brazing, soldering, and welding equipment	Minn. R. 7011.0515; Minn. R. 7011.0610; Minn. R. 7011.0715
3(H)(4)	Blueprint copiers and photographic processes	Minn. R. 7011.0110
3(J)	Fugitive dust from unpaved plant entrance roads and parking lots	Minn. R. 7011.0150
3(K)	Infrequent use of spray paint equipment for routine housekeeping or plant upkeep activities not associated with primary production processes at the stationary source, such as spray painting of buildings, machinery, vehicles, and other supporting equipment	Minn. R. 7011.0715
4	- Internal combustion engines burning distillate oil, gasoline, natural gas, or propane - VOC fugitives from pumps, valves, flanges on fuel oil tanks - VOC fugitive emissions from parts washers - Sandblasting - Small propane fired furnaces and generators - Gluing equipment - Various oil tanks; combined tankage approximately 343,000 gallons	Minn. R. 7011.0715

TECHNICAL SUPPORT DOCUMENT
For
AIR EMISSION PERMIT NO. 04900030-003

This Technical Support Document (TSD)is intended for all parties interested in the permit and to meet the requirements that have been set forth by the federal and state regulations (40 CFR § 70.7(a)(5) and Minn. R. 7007.0850, subp. 1). The purpose of this document is to provide the legal and factual justification for each applicable requirement or policy decision considered in the determination to issue the permit.

1. General Information

1.1 Applicant and Stationary Source Location

Stationary Source/Address (SIC Code: **4911**)	Corporate/Company Owner
1717 Wakonade Drive East Welch, MN 55089 Goodhue County	Northern States Power Company, doing business as Xcel Energy (Xcel Energy)
Contact: John K. Chelstrom Phone: 612-330-7682	414 Nicollet Mall (Environmental Services Dept.) Minneapolis, MN 55401

1.2 Description of the Facility

This air emission facility is part of the Northern States Power Prairie Island Nuclear Generating Plant. This facility generates 1076 MW of electricity. The air emission facility is composed of one distillate oil-fired heating boiler and 12 diesel-fired engines for emergencies, to generate power, pump cooling water, or pump water for fire fighting. The generators and water pumps are required by the U.S. Nuclear Regulatory Commission.

1.3 Description of any Changes Allowed with this Permit Issuance

This reissuance includes a major amendment to increase the NO_x limit for each diesel engine from 3.35 to 4.0 lbs/mmBTU heat input to allow for some cushion for stack testing the larger diesel engines. As a result, the fuel usage limit will be decreased from 83955 to 70238 gallons/month. This is a Title I condition emission limit to restrict facility NO_x potential emissions to less than the major source level of 250 tons/year.

Other changes made through this permit action
Updated standard language for any outdated requirements
Total Facility – added performance testing requirements to total facility level
GP 001 – updated performance testing requirements based on most recent tests
EU 001 – Removed performance testing requirements

Note: All performance tests were reviewed and accounted for up to 10/27/06.

1.4 Permit History

Permit Number and Issuance Date	Action Authorized
04900030-002 (6/3/03)	Changed requirement to submit modeling protocol and results to a requirement to submit modeling information
04900030-001 (6/22/00)	Part 70 Total Facility Permit issuance

1.5 Facility Emissions

Table 1. Total Facility Potential to Emit Summary

	PM (tpy)	PM_{10} (tpy)	SO_2 (tpy)	NO_x (tpy)	CO (tpy)	VOC (tpy)	All HAPs (tpy)
Total Facility Potential Emissions Increases	(1.2)	(1.2)	(5.8)	0	(9.8)	(1.0)	(0.02)
Total Facility Limited Potential Emissions	6.3	6.6	42.7	239.7	51.0	5.4	0.1
Total Facility Actual Emissions (2004)	0.33	0.27	0.18	10.76	3.91	0.38	HAPs not reported in emission inventory

Table 2. Facility Classification

Classification	Major/Affected Source	Synthetic Minor	Minor
PSD		NO_x, CO, SO_2	PM_{10}, PM, VOC
Part 70 Permit Program	NO_x	CO, SO_2, PM_{10}	VOC
Part 63 NESHAP	--	--	Single and Total HAP

2. Regulatory and/or Statutory Basis

New Source Review

The facility has limits to keep it a synthetic minor source under New Source Review regulations. No changes are authorized by this permit.

Part 70 Permit Program

The facility is a major source under the Part 70 permit program.

New Source Performance Standards (NSPS)

There are no New Source Performance Standards applicable to the operations at this facility.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

The facility is a minor source for HAPs under 40 CFR pt. 63. Thus, no NESHAPs apply.

Minnesota State Rules

Portions of the facility are subject to the following Minnesota Standards of Performance:

- Minn. R. 7011.0510 Standards of Performance for Existing Indirect Heating Equipment
- Minn. R. 7011.2300 Standards of Performance for Stationary Internal Combustion Engines

Table 3. Regulatory Overview of Units Affected by the Permit Amendment

Unit	Applicable Regulations	Comments:
Total Facility	40 CFR pt. 50; Minn. R. 7009.0100 to 7009.0080	Added NAAQS requirement
GP 001 Internal Combustion Engines	Title I limits to avoid PSD; Minn. R. 7007.0800, subp. 2	Increased NO_x limit to 4.0 lbs/mm BTU heat input for each emission unit
		Decreased Fuel Usage to 70,238 gallons/month
	Minn. R. 7017.2020, subp. 1	Updated Performance Testing requirements based off most recent tests conducted
EU 001 Boiler 1	Minn. R. 7017.2020, subp. 1	Removed Performance Testing requirements based off most recent tests conducted and very low run times. (6.1 hr in 2005, 25.1 in 2004) This is a backup facility heating boiler, only would be needed if both nuclear generators were down at the same time during the winter heating season. Operating hours for this unit over the last 5 years have been solely for exercising the unit and performance testing.

3. Technical Information

3.1 Periodic Monitoring

In accordance with the Clean Air Act, it is the responsibility of the owner or operator of a facility to have sufficient knowledge of the facility to certify that the facility is in compliance with all applicable requirements.

In evaluating the monitoring included in the permit, the MPCA considers the following:

- The likelihood of violating the applicable requirements;
- Whether add-on controls are necessary to meet the emission limits;
- The variability of emissions over time;
- The type of monitoring, process, maintenance, or control equipment data already available for the emission unit;
- The technical and economic feasibility of possible periodic monitoring methods; and
- The kind of monitoring found on similar units elsewhere.

Table 4 summarizes the periodic monitoring requirements for those emission units for which the monitoring required by the applicable requirement are different or new from the previous permit. All other monitoring requirements are still applicable

Table 4. Periodic Monitoring

Emission Unit or Group	Requirement (basis)	Additional Monitoring	Discussion
GP 001 Internal Combustion Engines	Operating Hours for EU 004 and EU 005	Recordkeeping	Records to show that hours of operation were less than 100 hours for the year. When over 100 hours, an Initial Performance Test is required, then a Testing Frequency Plan, which will make this requirement obsolete.
	12 month rolling average fuel limit	Recordkeeping	Records to show compliance with fuel usage limit

3.2 Calculations of Potential to Emit

Attachment 1 to this TSD contains the PTE calculations, which summarizes the PTE of the Facility. Emission Factors were obtained from AP-42 Chapters 1.3 and 3.4.

3.3 Insignificant Activities

Xcel Energy – Prairie Island Nuclear has several operations which are classified as insignificant activities. These are listed in Appendix B to the permit.

3.4 Permit Organization

In general, the permit meets the MPCA Delta Guidance for ordering and grouping of requirements. One area where this permit deviates slightly from Delta guidance is in the use of appendices. While appendices are fully enforceable parts of the permit, in general, any requirement that the MPCA thinks should be tracked (e.g., limits, submittals, etc.), should be in Table A or B. The main reason is that the appendices are word processing sections and are not part of the tracking system. Violation of the appendices can be enforced, but the computer system will not automatically generate the necessary enforcement notices or documents. Staff must generate these.

3.5 Comments Received

Public Notice Period: November 15, 2006 – December 14, 2006
EPA 45-day Review Period: November 15, 2006 – December 29, 2006
No comments were received during the review periods.

4. Conclusion

Based on the information provided by Xcel Energy – Prairie Island Nuclear, the MPCA has reasonable assurance that the operation of the emission facility, as described in the Air Emission Permit No. 04900030-003, and this TSD, will not cause or contribute to a violation of applicable federal regulations and Minnesota Rules.

Staff Members on Permit Team: Trevor Shearen (permit writer/engineer)
Emily Hansen (enforcement)
Steve Gorg (stack testing)
Marshall Cole (peer reviewer)

Attachment: 1. Total Facility PTE Summary

ATTACHMENT 1:
Total Facility PTE Summary

Table 5. Total Facility PTE

Pollutant	EU 001[1]	GP 001[2]		Total Facility	
	PTE (ton/yr)	Current PTE (ton/yr)	Limited PTE (ton/yr)	Current PTE[3] (ton/yr)	Limited PTE[4] (ton/yr)
NO_x	3.67	236.2	236.0	239.9	239.7
SO_x	13.21	35.3	29.5	48.5	42.7
CO	0.93	59.9	50.1	60.9	51.1
PM	0.37	7.05	5.90	7.42	6.27
PM_{10}	0.37	7.05	5.90	7.42	6.27
Total VOC	0.05	6.35	5.31	6.39	5.36
Total HAPs	0.009	0.105	0.088	0.11	0.10

[1] EU 001 (ton/yr) from Table 6
[2] GP 001 (ton/yr) from Table 7
[3] Total Facility Current PTE (ton/yr) = EU 001 PTE (ton/yr) + GP 001 Current PTE (ton/yr)
[4] Total Facility Limited PTE (ton/yr) = EU 001 PTE (ton/yr) + GP 001 Limited PTE (ton/yr)

Table 6. EU 001 – Heating Boiler

Pollutant	Emission Factor (lb/gal)	Uncontrolled PTE[1] (ton/yr)	Limited PTE[2] (ton/yr)	Actual Emissions[3] (ton/yr)
NO_x	0.0197 [15]	34.13	3.67	0.006
SO_x	0.0710 [11]	122.84	13.21	0.022
CO	0.0050 [11]	8.65	0.93	0.002
PM	0.0020 [11]	3.46	0.37	0.001
PM_{10}	0.0020 [11]	3.46	0.37	0.001
Total VOC	0.0003 [12]	0.44	0.05	0.000
Benzene	2.14E-07 [13]	3.70E-04	3.98E-05	6.53E-08
Ethylbenzene	6.36E-08 [13]	1.10E-04	1.18E-05	1.94E-08
Formaldehyde	3.30E-05 [13]	5.71E-02	6.14E-03	1.01E-05
Naphthalene	1.13E-06 [13]	1.96E-03	2.10E-04	3.45E-07
1,1,1 Trichloroethane	2.36E-07 [13]	4.08E-04	4.39E-05	7.20E-08
Toluene	6.20E-06 [13]	1.07E-02	1.15E-03	1.89E-06
Xylenes	1.09E-07 [13]	1.89E-04	2.03E-05	3.32E-08
Arsenic	5.48E-07 [14]	9.48E-04	1.02E-04	1.67E-07
Beryllium	4.11E-07 [14]	7.11E-04	7.65E-05	1.25E-07
Cadmium	4.11E-07 [14]	7.11E-04	7.65E-05	1.25E-07
Chromium	4.11E-07 [14]	7.11E-04	7.65E-05	1.25E-07
Copper	8.22E-07 [14]	1.42E-03	1.53E-04	2.51E-07
Lead	1.23E-06 [14]	2.13E-03	2.29E-04	3.76E-07
Manganese	8.22E-07 [14]	1.42E-03	1.53E-04	2.51E-07
Mercury	4.11E-07 [14]	7.11E-04	7.65E-05	1.25E-07
Nickel	4.11E-07 [14]	7.11E-04	7.65E-05	1.25E-07
Selenium	2.06E-06 [14]	3.56E-03	3.82E-04	6.27E-07
Zinc	5.48E-07 [14]	9.48E-04	1.02E-04	1.67E-07
Total HAPs		8.48E-02	9.12E-03	1.50E-05

Max Process Rate	395 gal/hr
Monthly Fuel Limit	31002 gal/mo
2005 Actual Fuel Use	610 gal/yr

[1] Uncontrolled PTE (ton/yr) = Emission Factor (lb/gal) x Max Process Rate x 8760 (hr/yr) / 2000 (lb/ton)
[2] Limited PTE (ton/yr) = Emission Factor (lb/gal) x Monthly Fuel Limit (gal/month) x 12 (month/yr) / 2000 (lb/ton)
[3] Actual Emissions (ton/yr) = Emission Factor (lb/gal) x 2005 Actual Fuel Use (gal/yr) / 2000 (lb/ton)
[11] AP-42 Table 1.3-1 (9/98)
[12] AP-42 Table 1.3-3 (9/98)
[13] AP-42 Table 1.3-9 (9/98)
[14] AP-42 Table 1.3-10 (9/98): (lb/gal) = (lb/MM Btu) x (0.137 MM Btu/gal)
[15] Stack test

Table 7. GP 001 – Internal Combustion Engines

Pollutant	Emission Factor (lb/MMBtu)	Current Limited PTE[1] (ton/yr)	Proposed Limited PTE[2] (ton/yr)	Actual Emissions[3] (ton/yr)
NO_x (current)	3.35 [11]	236.2	N/A	17.4
NO_x (proposed)	4.00 [12]	N/A	236.0	20.8
SO_x	0.50 [13]	35.26	29.50	2.60
CO	0.85 [14]	59.94	50.15	4.43
PM	0.10 [14]	7.05	5.90	0.52
PM_{10}	0.10 [14]	7.05	5.90	0.52
Total VOC	0.09 [14]	6.35	5.31	0.47
Acetaldehyde	2.52E-05 [15]	1.78E-03	1.49E-03	1.31E-04
Acrolein	7.88E-06 [15]	5.56E-04	4.65E-04	4.10E-05
Benzene	7.76E-04 [15]	5.47E-02	4.58E-02	4.04E-03
Formaldehyde	7.89E-05 [15]	5.56E-03	4.66E-03	4.11E-04
Naphthalene	1.30E-04 [16]	9.17E-03	7.67E-03	6.77E-04
Toluene	2.81E-04 [15]	1.98E-02	1.66E-02	1.46E-03
Xylenes	1.93E-04 [15]	1.36E-02	1.14E-02	1.01E-03
Total HAPs		1.05E-01	8.80E-02	7.77E-03

Current Fuel Usage Limit	83955 gal/month
Proposed Fuel Usage Limit	70238 gal/month
2005 Actual Rolling Average Fuel Use	6200 gal/month
Distillate Oil Heat Content	0.14 MM Btu/gal

[1] Current Limited PTE (ton/yr) = Emission Factor (lb/MM Btu) x Distillate Oil Heat Content (MM Btu/gal) x Current Fuel Usage Limit (gal/month) x 12 (month/yr) / 2000 (lb/ton)

[2] Proposed Limited PTE (ton/yr) = Emission Factor (lb/MM Btu) x Distillate Oil Heat Content (MM Btu/gal) x Proposed Fuel Usage Limit (gal/month) x 12 (month/yr) / 2000 (lb/ton)

[3] Actual Emissions (ton/yr) = Emission Factor (lb/MM Btu) x Distillate Oil Heat Content (MM Btu/gal) x 2005 Actual Rolling Average Fuel Use (gal/month) x 12 (month/yr) / 2000 (lb/ton)

[11] Current Limit
[12] Proposed Limit
[13] Distillate Oil Limit
[14] AP-42, 10/96, Table 3.4-1
[15] AP-42, 10/96, Table 3.4-3
[16] AP-42, 10/96, Table 3.4-4

Climate of Minnesota

Introduction

This publication consists of a narrative that describes some of the principal climatic features and a number of climatological summaries for stations in various geographic regions of the State. The detailed information presented should be sufficient for general use; however, some users may require additional information.

The National Climatic Data Center (NCDC) located in Asheville, North Carolina is authorized to perform special services for other government agencies and for private clients at the expense of the requester. The amount charged in all cases is intended to solely defray the expenses incurred by the government in satisfying such specific requests to the best of its ability. It is essential that requesters furnish the NCDC with a precise statement describing the problem so that a mutual understanding of the specifications is reached.

Unpublished climatological summaries have been prepared for a wide variety of users to fit specific applications. These include wind and temperature studies at airports, heating and cooling degree day information for energy studies, and many others. Tabulations produced as by-products of major products often contain information useful for unrelated special problems.

The Means and Extremes of meteorological variables in the Climatography of the U.S. No.20 series are recorded by observers in the cooperative network. The Normals, Means and Extremes in the Local Climatological Data, annuals are computed from observations taken primarily at airports.

The editor of this publication expresses his thanks to those State Climatologists, who, over the years, have made significant and lasting contributions toward the development of this very useful series.

State and Station Normals are available at:
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Climate of Minnesota

Topographic Features- The State of Minnesota covers 84,068 square miles. There are 11,842 lakes greater than 10 acres. The State's jurisdiction covers 2,546 square miles of Lake Superior. Minnesota extends about 400 miles south to north between latitudes 43.5 and 49° North, and averages 275 miles east to west between longitudes 89.5 and 97° West.

Elevations are less than 1,200 feet near each of the three major rivers, the: Red, Minnesota and Mississippi (except in the northern part). There are three areas where elevations are greater than 1,600 feet: the Iron Range, paralleling the north shore of Lake Superior; the Coteau Des Prairies (also known as Buffalo Ridge), extending out of South Dakota across the southwest portion of the State; and a small area in the Lake Itasca region. The highest point above sea level, Eagle Mountain, in the extreme northeast portion of the State, is 2,301 feet, and the lowest is 602 feet along the shores of Lake Superior. Minnesota can be considered to have a continental divide in three directions: drainage is toward Hudson Bay to the north; toward the Atlantic Ocean to the east; and toward the Gulf of Mexico to the south.

Temperature- Minnesota has a continental-type climate and is subject to frequent outbreaks of continental polar air throughout the year, with occasional Arctic outbreaks during the cold season. Occasional periods of prolonged heat occur during summer, particularly in the southern portion of Minnesota, when warm air pushes northward from the Gulf of Mexico and the southwestern United States. Pacific Ocean air masses that move across the Western United States produce comparatively mild and dry weather at all seasons.

Mean annual temperatures range from 36 degrees Fahrenheit (° F) in the extreme north to 49 degrees along the Mississippi River in the southeast. State temperature extremes range from -60 to 114° F.

Monthly mean temperatures vary from 85 in the southwest to -11° F in the northwest. Mean temperatures during January in the northern portions of the State average near 4° F; this is 10 degrees colder than temperatures recorded at stations near Lake Superior and in southern Minnesota.

The mean temperature in July for the State averages about 70° F in most places but this is five to 10 degrees warmer than at stations near Lake Superior. Thus, Lake Superior stations are cool in summer and relatively warm in winter.

Dew point temperatures in most areas range from a high of 70° F in July to a low of 6 in January. However, the dew point temperatures average about five to 10 degrees lower in the extreme northern portion of the State at all seasons.

Precipitation- Although the total precipitation is important, its distribution during the growing season is even more significant. For the most part, native vegetation grows for seven months (April to October) and row crops grow for five months (May through September). During the latter five-month period, approximately two-thirds of the annual precipitation occurs. Mean annual precipitation is 35 inches in extreme southeast Minnesota, an amount that gradually decreases to 19 inches in the extreme northwest portion of the State. At most locations there have been months with no precipitation recorded. Statewide, two of the driest years were 1910 and 1976, while two of the wettest were 1965 and 1977.

Seasonal snowfall averages near 70 inches in the highlands along the north shore of Lake Superior in northeast Minnesota, gradually decreases to 40 inches along the Iowa border in the south, and is around 40 inches along the North Dakota and South Dakota borders in the west. Snow cover of one inch or more over the State occurs on an average of about 110 days annually, ranging from 85 days in the south to 140 days in the north.

Heavy snowfalls of greater than 4 inches are common any time from mid-November through mid-April. Heavy snowfalls with blizzard conditions affect the State on the average about two times each winter. The most devastating blizzards were those of January 11 - 13, 1888, and of November 11 - 12, 1940, which resulted in the loss of many lives and a heavy toll of livestock. Blizzard conditions are when visibilities are reduced to less than ¼ mile for several hours due to falling and/or blowing snow. The wind must be at least 35 mph. Another memorable blizzard occurred on October 31, 1991 and is known as the "Halloween Blizzard". The Twin Cities received 28.4 inches of snow from this storm which lasted until November 3.

Conditions of severe drought with an annual Palmer Drought Index of -3 or lower are expected on the average about once in 10 years in southwest and west central Minnesota, to about once in 25 years over eastern Minnesota. The northeast part of the state experiences severe drought about once in 50 years.

Thunderstorms generally cause more damage to property in Minnesota than any other weather factor. The annual frequency of thunderstorm days is about 45 days in southern Minnesota, decreasing to about 30 days along the Canadian border. Generally, 80 percent or more of these storms occur during the heavier rainfall months--from May through September. Damaging local windstorms, tornadoes, hail, and heavy rains sometimes occur with better-developed thunderstorms.

The "tornado month" in the State is June, with July next, and then May. During these three months, over 75 percent of all tornadoes occur; May has about 17 percent, June around 33 percent, and July approximately 28 percent. Tornadoes have never been reported in the State during December, January and February. The average number reported annually is 35. The southern half of Minnesota has three to four times as many tornadoes as the northern half of the State. The deadliest Minnesota tornado of record was the Saint Cloud-Sauk Rapids tornado on April 14, 1886, when 74 lives were lost. The most damaging tornadoes were those occurring in the northern part of Minneapolis in the late afternoon of May 6, 1965, causing about $280 million (2001 figure) in damage.

The frequency of hail shows a high of three to four days annually in southwestern Minnesota, decreasing to near two days in the northern portion of the State. The month with the most hail is June, with May next, and then July. During these three months, about 60 percent of the hail occurs; June has 24 percent, May has 20 percent and July has 16 percent. The size of the hail reported is generally in the pea to dime-sized category, with several reports annually of baseball-size and larger.

Freezing rain and glaze storms are not numerous, but do coat the roads several times each season in Minnesota. The more severe ice storms cause extensive damage to utility lines and trees; such storms are not as common in the northern part of the State as they are in the south and southeast portions.

Local flash flooding can be very destructive along the steep bluffs of Lake Superior and the hilly terrain and narrow valleys of southeast Minnesota; however, flash flooding can occur anywhere in Minnesota. Flash flooding (defined as a six inches or more rain in 24 hours) occurs on average, three times a year somewhere in the state.

The agricultural areas of Minnesota can be divided into three approximately equal parts: national and State forest land, farmlands for row crops, and farmlands for pasture and hay. Corn is the major crop by acreage, followed by about equal acreages of: hay, oats and soybeans. Farm income from marketing shows that about two-thirds of the total comes from livestock and with one-third from field crops.

The freeze-free (air temperatures greater than 32° F) growing season generally starts about the second week of May in the south and the first of June in the north and ends about mid-September in the north and during the first week of October in the south. The area in southeast Minnesota along the Mississippi River has the longest growing season, approximately 160 days. The southern one-third of the State averages from 140 to 150 days. The North Central Division and the ridges of the Iron Range average a growing season of only about 90 to 100 days. There are bog areas in northern Minnesota that have reported freezing temperatures every month of the year.

The average number of Growing Degree Days (GDD) over the freeze-free growing season for agricultural areas is less than 2,000 in the north, but ranges to near 2,700 GDD in the south (The GDD is derived from the excess of daily mean temperatures over 50° F; minimum temperatures cannot fall below 50 nor can maximum temperatures rise above 86 for computational purposes.)

Annual lake evaporation varies from 35 inches in a year in the Southwest to about 20 inches in Northeast Division. Annual pan evaporation varies from about 50 inches in a year in the southwest to less than 30 inches in the northeast. The actual daily evapotranspiration (evaporation from land and plant surfaces) or ET averages about 0.15 inch of water during the months of June, July and August for all of the State except the North Central and Northeast Divisions. Row crops average approximately 20 inches of ET in a year; however, the average annual potential ET (adequate soil moisture at all times) is near 24 inches.
Solar radiation varies from an average of about 120 langleys a day in December to near 570 langleys a day in July. (The langley is a unit of energy per unit area commonly employed in

radiation theory; it is equal to one gram-calorie per square centimeter.) Sunshine amounts vary from a low in November of nearly 40 percent of possible sunshine hours to a high of about 70 percent in July, with an annual average of 58 percent. The daylight length varies from about 8.5 hours in December to 16 hours in June.
The soil freezes about the first week of December and thaws about mid-April. Average maximum freeze depth in the State ranges from three to four feet in the south to five to six feet in the north, exclusive of forested regions where the freezing depth is ordinarily much shallower.

Climate and the Economy- Minnesota climate, in conjunction with some 15,000 lakes interspersed in forests and wooded areas, produces an almost ideal environment for variety of recreational activities. The summer season (May through August), with its warm days and cool nights, attracts summer vacationers.

Common activities are camping, fishing, swimming, boating, canoeing and hiking. The recreational activity in the fall season (September through November) is dominated by the hunters. Deer, moose, pheasant, duck, geese, grouse and occasionally bear are the principal targets. For the non-hunters, autumn is beautiful for the annual change of the summer leaves to hues of yellow, orange and red.

The winter season (December through March) has sufficient snowfalls and low temperatures to maintain conditions for skiing, snowmobiling, skating (hockey) and ice fishing. The transition season is the month of April when the snow and ice melt.

A special recreational area in northern Minnesota has been set aside and regulated for canoeing only. This area: known as the Boundary Water Canoe Area, is a 110-mile canoe region that extends along the Canadian border and into Canada. There are also 72 state parks and numerous other camping facilities that offer camping and recreation.

For more information, please contact:

State Climatology Office DNR-Waters
www.climate.umn.edu

Climate of Minnesota

From Wikipedia, the free encyclopedia

The **climate of Minnesota** is typical of a continental climate with cold winters and hot summers. The state's location in the Upper Midwest allows it to experience some of the widest variety of weather in the United States, with each of the four seasons having its own distinct characteristics. The areas near Lake Superior in the Minnesota Arrowhead region experience weather unique from the rest of the state. The moderating effect of Lake Superior keeps the surrounding area relatively cooler in the summer and relatively warmer in the winter, giving that region more of a maritime climate. On the Köppen climate classification, the southern half of Minnesota, roughly from the Twin Cities region southward, falls in the warm summer humid continental climate zone (*Dfa*), and the northern two-thirds of Minnesota falls in the cool summer humid continental climate zone (*Dfb*).

On March 29, 1881 snowdrifts in western Minnesota were larger than locomotives.

Winter in Minnesota is characterized by cold (below freezing) temperatures and snowfall. Snow is the main form of winter precipitation, but freezing rain, ice, sleet, and sometimes even rain are all possible during the winter months. Common storm systems include Alberta clippers or Panhandle hooks, some of which evolve into blizzards. Annual snowfall extremes have ranged from over 170 inches (432 cm) in the rugged Superior Highlands of the North Shore to as little as 10 inches (25 cm) in southern Minnesota. Temperatures as low as −60 °F (−51 °C) have occurred during Minnesota winters. Spring is a time of major transition in Minnesota. Snowstorms are common in early spring, but by late spring as temperatures begin to moderate the state can experience tornado outbreaks, a risk which diminishes but does not cease through the summer and into the fall.

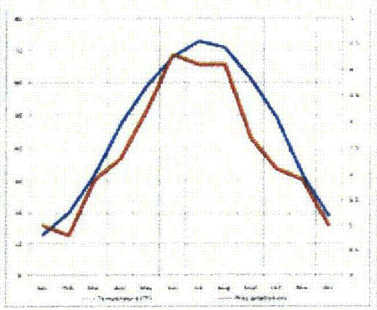
In summer, heat and humidity predominate in the south, while warm and less humid conditions are generally present in the north. These humid conditions help kick off thunderstorm activity 30–40 days per year. Summer high temperatures in Minnesota average in the mid 80s (30 °C) in the south to the upper 70s (25 °C) in the north, with temperatures as hot as 114 °F (46 °C) possible. The growing season in Minnesota varies from 90 days per year in the Iron Range to 160 days in southeast Minnesota. Tornadoes are possible in Minnesota from March through November, but the peak tornado month is June, followed by July, May, and August. The state averages 24 tornadoes per year. Minnesota is the driest state in the Midwest. Average annual precipitation across the state ranges from around 35 inches (890 mm) in the southeast to just 20 inches (510 mm) in the northwest. Autumn weather in Minnesota is largely the reverse of spring weather. The jet stream, which tends to weaken in summer, begins to re-strengthen, leading to a quicker changing of weather patterns and an increased variability of temperatures. By late October and November these storm systems become strong enough to form major winter storms. Fall and spring are the windiest times of the year in Minnesota.

Contents

General climatology

Because of its location in the center of North America Minnesota experiences temperature extremes characteristic of a continental climate, with cold winters and mild to hot summers in the south and frigid winters and generally cool summers in the north.[1] Each season has distinctive upper air patterns which bring different weather conditions with them. Being 1,000 miles (1,609 km) from any large body of water (with the exception of Lake Superior), temperatures and precipitation in Minnesota can vary widely. Minnesota is far enough north to experience −60 °F (−51 °C) temperatures and blizzards during the winter months, but far enough south to experience 114 °F (46 °C) temperatures and tornado outbreaks in the summer.[2] The 174 degree Fahrenheit (97 °C) variation between Minnesota's highest and lowest temperature is the 11th largest

variation of any U.S. state, and 3rd largest of any non-mountainous state (behind North Dakota and South Dakota).[3]



The average daily temperature of Minneapolis, Minnesota varies from 13 °F (−11 °C) to 73 °F (−10 °C to 23 °C).

Minnesota is far from major sources of moisture and is in the transition zone between the moist East and the arid Great Plains. Annual average precipitation across the state ranges from around 35 inches (890 mm) in the southeast to 20 inches (510 mm) in the northwest.[4] Snow is the main form of precipitation from November through March, while rain is the most common the rest of the year. Annual snowfall extremes have ranged from over 170 inches (432 cm) in the rugged Superior Highlands of the North Shore to as little as 2.3 inches (5.8 cm) in southern Minnesota.[5][6] It has snowed in Minnesota during every month with the exception of July, and the state averages 110 days per year with snow cover of an inch (2.5 cm) or greater.[7]

On the Köppen climate classification, the southern half of Minnesota, roughly from the Twin Cities region southward, falls in the warm summer humid continental climate zone (*Dfa*), and the northern two-thirds of Minnesota falls in the cool summer humid continental climate zone (*Dfb*).

Lake Superior

The cool, moist air near Lake Superior makes fog a frequent occurrence near the shore.[8]

Lake Superior moderates the climate of those parts of Minnesota's Arrowhead Region near the shore. The lake acts as a heat sink, keeping the state's North Shore area relatively cooler in the summer and warmer in the winter.[9] While this effect is marked near the lake, it does not reach very far inland. For example, Grand Marais on the lakeshore has an average July high temperature of 70 °F (21 °C), while Virginia, at about the same latitude but inland about 100 miles (161 km) to the west, has an average July high of 77 °F (25 °C). Conversely, Virginia's average high temperature in January is 15 °F (−9 °C), while Grand Marais' is 23 °F (−5 °C).[10] Just a few miles inland from Lake Superior are the Sawtooth Mountains, which largely confine the marine air masses and associated precipitation to lowers elevation near the lake.[11]

The prevailing northwest winter winds also limit the lake's influence. Places near the shoreline can receive lake-effect snow, but because the state lies north and west of the lake, snowfall amounts are not nearly as large as they are in locations like Wisconsin and Michigan that lie downwind to the south.[8] Even so, the single largest snowstorm in Minnesota history was a lake effect event. On January 6, 1994 Finland, Minnesota, received 36 inches (91 cm) of lake effect snow in 24 hours, and 47 inches (119 cm) over a three day period. Both are Minnesota records. At 85 inches (216 cm) per year, the port city of Duluth has the highest average snowfall total of any city in Minnesota.[12] At 58.9 °F (14.9 °C), Grand Marais has the lowest average summer temperature of any city in the state.[13]

The climatological effects of Lake Superior tend to stifle convection, thus limiting the potential for tornadoes.[7] Although Cook and Lake

counties are two of the largest counties in the state, they have experienced only 7 tornadoes in the past 56 years.[14] One of those tornadoes was a large F3 that occurred in the 1969 Minnesota tornado outbreak.

Statistics

Temperature

Average Temperatures in Minnesota in °Fahrenheit (°Celsius)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Alexandria[15]	8 (−13)	15 (−9)	27 (−3)	43 (6)	56 (13)	65 (18)	70 (21)	68 (20)	58 (14)	45 (7)	28 (−2)	14 (−10)	41 (5)
Brainerd[16]	6 (−14)	13 (−11)	26 (−3)	42 (6)	56 (13)	64 (18)	69 (21)	66 (19)	56 (13)	44 (7)	28 (−2)	13 (−11)	40 (4)
Duluth[17]	10 (−12)	17 (−8)	26 (−3)	39 (4)	48 (9)	58 (14)	66 (19)	65 (18)	56 (13)	45 (7)	31 (−1)	17 (−8)	40 (4)
Grand Marais[18]	14 (−10)	19 (−7)	28 (−2)	38 (3)	47 (8)	53 (12)	61 (16)	63 (17)	55 (13)	45 (7)	32 (0)	19 (−7)	39 (4)
International Falls[19]	3 (−16)	11 (−12)	24 (−4)	39 (4)	53 (12)	62 (17)	66 (19)	64 (18)	53 (12)	42 (6)	24 (−4)	9 (−13)	37 (3)
Redwood Falls[20]	13 (−11)	20 (−7)	32 (−0)	47 (8)	60 (16)	70 (21)	74 (23)	71 (22)	62 (17)	49 (9)	32 (0)	18 (−8)	46 (8)
Thief River Falls[21]	3 (−16)	11 (−12)	24 (−4)	42 (6)	56 (13)	64 (18)	69 (21)	67 (19)	56 (13)	44 (7)	24 (−4)	9 (−13)	39 (4)
Twin Cities[22]	13 (−11)	20 (−7)	32 (0)	47 (8)	59 (15)	68 (20)	73 (23)	71 (22)	61 (16)	49 (9)	32 (0)	19 (−7)	45 (7)
Winona[23]	18 (−8)	24 (−4)	36 (2)	50 (10)	62 (17)	71 (22)	76 (24)	73 (23)	64 (18)	52 (11)	37 (3)	23 (−5)	49 (9)
Worthington[24]	11 (−12)	18 (−8)	29 (−2)	44 (7)	57 (14)	67 (19)	71 (22)	68 (20)	59 (15)	47 (8)	30 (−1)	17 (−8)	43 (6)

Precipitation

Average Precipitation in Minnesota in inches (millimetres)

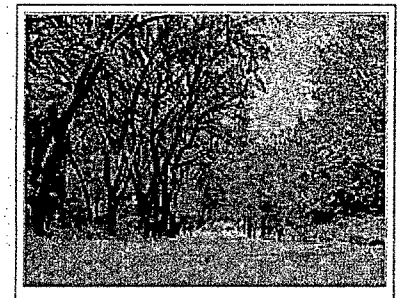
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Alexandria[15]	1.0 (25)	0.7 (18)	1.5 (38)	1.9 (48)	3.0 (76)	4.4 (112)	3.3 (84)	3.6 (91)	2.7 (69)	2.2 (56)	1.2 (30)	0.6 (15)	26.0 (660)
Brainerd[16]	0.8 (20)	0.6 (15)	1.5 (38)	2.0 (51)	3.3 (84)	4.2 (107)	4.1 (104)	3.6 (91)	2.8 (71)	2.5 (64)	1.6 (41)	.7 (18)	27.7 (704)
Duluth[17]	1.0 (25)	0.5 (13)	1.4 (36)	1.6 (41)	2.3 (58)	3.7 (94)	3.7 (94)	3.7 (94)	3.7 (94)	1.9 (48)	1.4 (36)	0.8 (20)	25.6 (650)
Grand Marais[18]	0.7 (18)	0.6 (15)	1.1 (28)	1.3 (33)	2.5 (64)	3.4 (86)	3.4 (86)	3.1 (79)	3.4 (86)	2.6 (66)	1.8 (46)	0.8 (20)	24.6 (625)
International Falls[19]	0.8 (20)	0.6 (15)	1.0 (25)	1.4 (36)	2.6 (66)	4.0 (102)	3.4 (86)	3.1 (79)	3.0 (76)	2.0 (51)	1.4 (36)	0.7 (18)	23.9 (607)
Redwood Falls[20]	0.7 (18)	0.6 (15)	1.7 (43)	2.5 (64)	3.1 (79)	4.1 (104)	3.8 (97)	3.6 (91)	2.5 (64)	1.9 (48)	1.6 (41)	0.6 (15)	26.6 (676)
Thief River Falls[21]	0.2 (5)	0.3 (8)	0.4 (10)	1.0 (25)	2.6 (66)	3.4 (86)	3.4 (86)	3.1 (79)	2.4 (61)	1.7 (43)	0.9 (23)	0.3 (8)	19.7 (500)
Twin Cities[22]	1.0 (25)	0.8 (20)	1.9 (48)	2.3 (58)	3.2 (81)	4.3 (123)	4.1 (104)	4.1 (104)	2.7 (69)	2.1 (53)	1.9 (48)	1.0 (25)	29.4 (747)
Winona[23]	1.4 (36)	0.7 (18)	1.8 (46)	3.5 (89)	3.9 (99)	4.2 (107)	4.4 (112)	4.7 (119)	3.9 (99)	2.2 (56)	2.2 (56)	1.3 (33)	34.2 (869)
Worthington[24]	0.7 (18)	0.6 (15)	1.9 (48)	2.7 (69)	3.4 (86)	4.6 (117)	3.6 (91)	3.5 (89)	2.6 (66)	2.0 (51)	1.7 (43)	0.7 (18)	27.8 (706)

See also: List of Minnesota weather records

Winter

Even though winter does not officially start until late December, Minnesota usually begins experiencing winter-like conditions in November, sometimes as early as late October. As with many other Midwestern states, winter in Minnesota is characterized by cold (below freezing) temperatures and snowfall. Weather systems can move in from the north, west, or south, with the majority of the weather being driven in from the north. A vigorous jet stream brings high and low-pressure systems through in quick succession, which can cause large temperature variations over a short period of time.

Temperature



A wintry, February day in St. Paul

As the last remnants of summertime air in the southern U.S. start to lose their grip, cold polar air building up in northern Canada starts to push farther south, eventually spreading into Minnesota. By the time December and January arrive, Minnesota is fully engulfed in the polar air and is then subjected to arctic air masses moving in. Because there are no natural barriers north or northwest of Minnesota to block arctic air from pouring south, Minnesota gets regular shots of the arctic air through the winter.[25] High pressure systems which descend south from the Canadian plains behind the fronts bring light winds, clear skies, and bitterly cold temperatures. The northern part of Minnesota gets the brunt of the cold air. International Falls, sometimes called the "Icebox of the nation", has the coldest average annual temperature of any National Weather Service first–order station in the contiguous United States at 37.4 °F (3.0 °C).[26] Tower, Minnesota, sinks below zero (−17 °C) an average of 71 times per year, and the ten coldest counties in the country, based on January minimums, are all located in Minnesota.[27] The air mass then slowly moderates as it moves south into the rest of the state. Alberta clippers alternate with these high-pressure systems, bringing high winds and some snowfall with them.

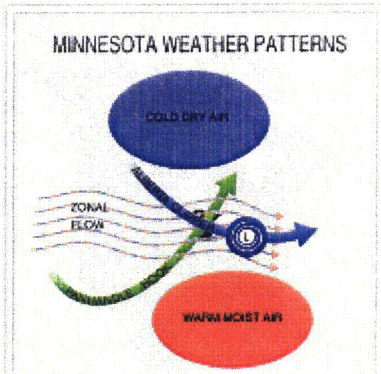
Minnesota occasionally gets breaks from the polar and arctic air when a zonal flow takes hold. This means that the jet stream will move in a west to east motion (rather than north to south) and warmer air push air from the western United States into the region. In Minnesota this pattern commonly leads to a prolonged period of above freezing high temperatures that gives Minnesotans a break from the winter freeze. Storms that move into Minnesota from a more westerly direction generally do not bring significant amounts of precipitation with them.[28]

Precipitation

Winter precipitation comes in a few different forms. Snow is the main form of precipitation, but freezing rain, ice, sleet and sometimes even rain are all possible during the winter months. Larger storm systems, often Panhandle hooks or other storms that occur with a meridional flow, can bring large amounts of snow and even blizzard conditions.[29]

Alberta Clippers

Alberta clippers are fast moving areas of low pressure that move through Minnesota during the winter months.[30] Clippers get their name from Alberta, Canada, the province from which they begin their southward track. (Other variations of the same type of storm systems are "Saskatchewan Screamers" or "Manitoba Maulers".[31]) Although clippers often originate over the northern Pacific Ocean, they lose most of their moisture through orographic lift when they collide with the Canadian Rockies. Because of the limited moisture content and quick movement of the systems, clippers rarely produce more than 6 in (15 cm) of snow as they pass through Minnesota.[32] The biggest effects of an Alberta Clipper are what follows them, and that is arctic air, high wind speed, and dangerous wind chills. This often results in severe blowing and drifting snow, and sometimes even blizzard conditions.[33] Alberta Clippers often proceed to become copious lake effect snow producers on the southern and eastern shores of the Great Lakes.[34]



Typical winter storm tracks in Minnesota.

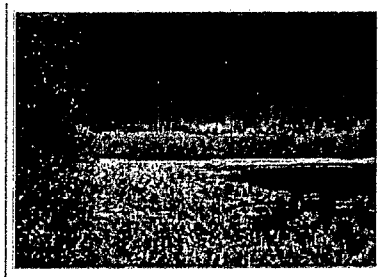
Panhandle Hooks

In terms of their characteristics, Panhandle hooks are nearly the opposite of Alberta clippers. Instead of forming in the north and dropping south, these low pressure systems form in the southwestern United States and then move northeast. They get their name from the location where they usually make their turn to the north; near the panhandles of Oklahoma and Texas. Unlike clippers, these storms usually have a great deal of moisture to work with. As the storms make their turn to the north, they pull in moist air from the nearby Gulf of Mexico and pull it northward toward Minnesota and other parts of the Midwest.[35] As these systems move to the northeast, there will usually be a heavy band of snow to the northwest of the low pressure center if there is enough cold air present. A wintery mix of precipitation, rain, or sometimes even thunderstorms will then often occur to the south of it.[36] Snowfall over a foot (30 cm) is not uncommon with a panhandle hook, and because of the high moisture content in these systems the snow is usually wet and heavy. Large panhandle hooks can become powerful enough to draw in arctic air after they pass by the state, leaving bitter cold temperatures and wind chills in their wake. Panhandle Hooks are responsible for some of the most famous blizzards that have occurred in the Midwest, including the Great Storm of 1975.[33]

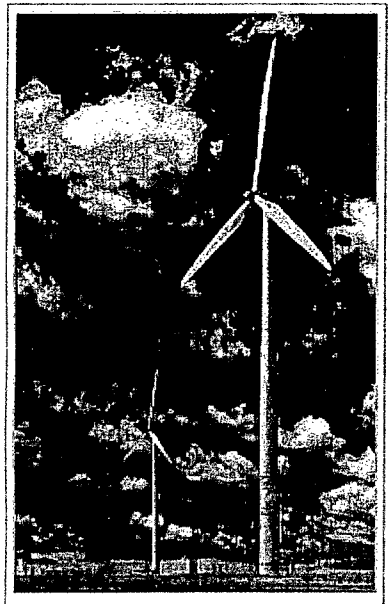
Spring

Spring is a time of major transition in Minnesota. As winter nears its end, the sun rises higher in the sky and temperatures begin to moderate. As this happens much of the Midwest starts to experience severe thunderstorms and tornadoes.[37] Storm systems that move inland from the Pacific begin to collide with the increasingly warm and moist air from the Gulf of Mexico. In the early part of the spring, Minnesota is usually not in a geographically favorable position to experience severe weather since the warm air needed for it has not yet pushed that far to the north.[38] Early spring tornado outbreaks do occur occasionally in

Minnesota though, as evidenced by the 1998 Comfrey – St. Peter tornado outbreak on March 29, 1998. More often, Minnesota is on the northern (cooler) side of major storm systems in the early spring, which instead results in only rain and possibly snow. Even though the winter snow pack typically starts to melt in southern Minnesota in early March, there is usually still enough cold air present over Canada to allow for major snow storms in Minnesota until late April.[39]



A Minnesota wetland during the month of April



Wind turbines in western Minnesota

As spring progresses, the jet stream starts to push storm systems farther to the north, and southern Minnesota becomes more prone to severe thunderstorms and tornadoes.[38] As spring moves into the later stages, the chances for snow continue to drop and eventually disappear, south to north. By the time it gets warm enough for severe weather in northern Minnesota, the strength of storm systems have usually started to decrease, which results in fewer severe storms in northern Minnesota compared to the southern part of the state.

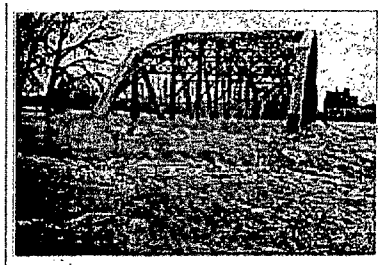
Wind

With the exception of areas along the shores of Lake Superior, winds in Minnesota generally prevail from the north and northwest in the winter, and south and southeast in the summer.[7] On average, fall and spring are the windiest times of the year in Minnesota. October is the windiest month in northwest Minnesota, while April is the windiest over the rest of the state.[40] Winds generally average between 9–11 mph (14–18 km/h) across the state, with one major exception. The heaviest winds in the state are found on the Buffalo Ridge, or Coteau des Prairies, a flatiron-shaped area extending from Watertown, South Dakota, diagonally across southwestern Minnesota and into Iowa. Created by two lobes of a glacier parting around a pre-existing plateau during the (Pleistocene) Ice Age, the Buffalo Ridge is ideal for wind power generation, with average wind speeds of 16.1 mph (26.8 km/h).[41]

Floods

Minnesota is prone to flooding in its major rivers by spring snowmelt runoff and ice jams. Spring flooding to some degree occurs almost annually on some Minnesota rivers, but major floods have occurred in 1965, 1969, 1997 and 2001.[42][43] The flooding in 1965 was the worst flood in Minnesota history on the Mississippi River, while the flooding in 1997 was the worst in history on the Red River.[44] The Red River flood of 1997 was aided heavily by the 11 blizzards that struck Minnesota that winter.[7][45] Besides heavy winter and spring snowfall, cold winter temperatures and heavy fall and spring rains causing sudden run-off surges are also common causes of spring river flooding in Minnesota.[46]

Minnesota is also prone to both river flooding and localized flash flooding by extended periods of heavy late-spring and summer rainfall. The Great Flood of 1993 on the Mississippi River was caused by copious amounts of rain that fell after the spring snow melt.[47] The 2007 Midwest flooding, which affected the hilly Driftless area of southeast Minnesota was the result of a training pattern of storms mixing warm moist air from Tropical Storm Erin with cooler Canadian air, resulting in record 24-hour rainfall totals of up to 17 inches (432 mm).[48]



A bridge connecting East Grand Forks, Minnesota to Grand Forks, North Dakota is submerged during the record flooding of the Red River in 1997.

Summer

Canoes ready for use on a summer afternoon at Lake Harriet in Minneapolis

During a Minnesota summer, heat and humidity predominate in the south, while warm and less humid conditions are generally present in the north. A main feature of summer weather in Minnesota and the Midwestern United States as a whole is the weakening of the jet stream, leading to slower movement of air masses, a general increase in the stability of temperatures, and less wind.[49] The strong wind that does blow almost always comes from the south, bringing in warm temperatures and humidity. These humid conditions and a jet stream that has pushed into the northern parts of the U.S. help kick off thunderstorm activity 30–40 days per year.[50]

Temperature

Daily average summer temperatures in Minnesota range from the low 70s (22 °C) in the south to the mid 60s °F (19 °C) in the north.[13] Because summer time air masses are not as volatile as in the winter, daily high and low temperatures rarely vary more than 15 degrees (7 °C) either side of normal. While summertime around much of the country means long stretches of hot and humid weather, Minnesota is located far enough north where shots of cooler, drier polar air frequently move in behind polar fronts dropping south from Canada.[6] The polar air typically does not stick around very long though and is quickly replaced by the warmer and more humid air from the Gulf of Mexico once again. The cool, dry polar air colliding with hot and humid summertime air keep the threat of thunderstorms and tornadoes around in Minnesota through July and August.[38] Northern

Minnesota is considerably cooler and less humid than southern Minnesota during the summer months. For example, Duluth's annual average temperature and dew point are 6 degrees (3.4 °C) cooler than Minneapolis'.[51]

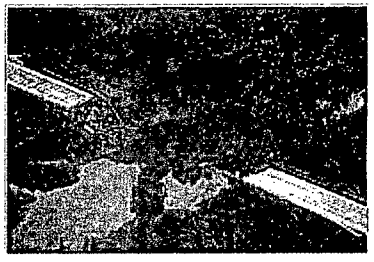
Showy ladyslippers bloom during the summer in Voyageurs National Park.

July is the hottest month in Minnesota state-wide and is usually the month when the peak heat waves occur. In July 1936, Minnesota and the rest of the Midwest suffered through its most severe heat wave on record. Most of the state was engulfed in 100 °F (38 °C) temperatures for several days in a row, and Minnesota's all time record high temperature of 114 °F (46 °C) was tied during this stretch. This heat wave was also responsible for setting the Twin Cities' all time record high of 108 °F (42 °C), as well as the all time record high of several other cities across the state.[52]

The region of Minnesota that experiences the hottest summer temperatures is the west. Coteau des Prairies can heat cities to the north of it similar to how places in the Rocky Mountains are warmed by Chinook winds. As southwest winds blow down the slope of Coteau des Prairies, the air compresses and warms. This makes the already hot air even hotter and often causes places like Beardsley and Moorhead to record the warmest temperature in the state, despite their higher latitudes.[6]

Precipitation

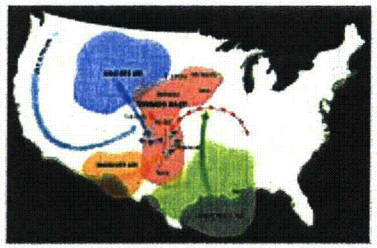
The summer months of June, July and August account for nearly half of the annual precipitation total across the state of Minnesota.[53] Most of this rain falls from thunderstorms, a frequent summer occurrence. Even though summer is the primary season for Minnesota to experience thunderstorms, they can occur from March to November. These storms can become severe, producing large hail, strong tornadoes, and large bow echos that result in damaging straight-line winds. Minnesota has experienced several major derecho events, most recently the Boundary Waters-Canadian Derecho which blew down millions of trees in the Boundary Waters Canoe Area Wilderness on July 4, 1999.[54]



A flash flood washed away a bridge on Minnesota State Highway 74 during the 2007 Midwest flooding.

Summertime thunderstorms are fueled by dew points that often reach into the 70s °F (21 °C) and sometimes even 80 °F (27 °C).[55] In addition to severe conditions, thunderstorms produce heavy rain and cloud to ground lightning. Heavy rain brings flash floods to Minnesota an average of three days per year.[25] With the exception of hail, summer precipitation in Minnesota is almost always in the form of rain. The lone exception is in far northern Minnesota, where in mid-September, small amounts of snow become a possibility.[56]

Droughts



Southern Minnesota is located on the edge of **Tornado Alley**

Droughts are an annual summer concern in Minnesota, especially for farmers. The growing season (which varies from 90 days per year in the Iron Range to 160 days in southeast Minnesota) is when Minnesota averages its highest percentage of annual precipitation, so a lack of rainfall during this time period can be devastating to crops.[25] The last major drought in Minnesota was in 1988. During that year, the period of April – July was the 2nd driest in the previous century, and the period of May – August was the hottest on record. The combination of dry skies and heat caused a severe drought which cost the state approximately 1.2 billion dollars in crop losses.[57]

Other memorable drought years were 1976 and the Dust Bowl years of the 1930s. During the dust bowl, inappropriate farming techniques enhanced by years of drought conditions led to dust storms in Minnesota and the other parts of the Midwest.[58] Drought conditions also have helped spawn forest fires. In 1894 the Great Hinckley Fire destroyed Hinckley killing an estimated 459 people, and in 1918 a forest fire killed 453 people in the vicinity of Cloquet.[59] More recently, in 2006, the Cavity Lake Fire burned 31,830 acres (129 km²) in the Boundary Waters Canoe Area Wilderness.[60]

Tornadoes

Tornadoes are possible in Minnesota from March – November, but the peak tornado month is June, followed by July, May, and August. Tornadoes are most common in the southern half of the state, which is located on the northern edge of tornado alley. Just over a third of tornadoes in Minnesota strike between 4 pm – 6 pm.[7] The state averages 24 tornadoes per year;[38] 99% of which have ratings of F2 or weaker. On average Minnesota has an F5 tornado once every 25 years. Some of the notable Minnesota tornadoes and outbreaks are:

An F3 tornado in southern Minnesota on August 24, 2006

- August 21, 1883: An F5 tornado struck Rochester, killing 37. This tornado led to the construction of a new hospital, which eventually evolved into the Mayo Clinic.
- April 14, 1886: A large tornado struck Sauk Rapids, killing 72. This was Minnesota's deadliest tornado on record.[61]
- June 22, 1919: The second deadliest tornado in Minnesota history tore through Fergus Falls, killing 59.
- May 6, 1965: Four F4 tornadoes ripped through the Twin Cities metro area (two of them in Fridley), killing 13.
- July 18, 1986: KARE 11 broadcast a tornado in Fridley from a news helicopter live on their 5 pm news.[62]
- June 16, 1992: Minnesota experienced its busiest tornado day ever with 27 recorded twisters. The largest tornado in this family was an F5 that struck Chandler, Minnesota, killing one. This is the most recent F5 tornado to strike the state.
- March 29, 1998: An F4 and an F3 tornado that were part of a larger outbreak tore through the towns of Comfrey and St. Peter. They killed two and caused damage in the millions of dollars in Minnesota's earliest recorded tornado outbreak.

Fall

Early fall in Voyageurs National Park.

Autumn weather in Minnesota is marked by the rapid decrease of severe thunderstorms, dramatic cooling, and eventually the possibility of blizzards. From September to December the average temperature in the state falls by approximately 43 °F (23 °C), the largest such temperature swing within any Minnesota season.[13] But with summer-time heat still prevalent in the southern U.S. and colder air quickly taking hold in Canada, Minnesota can be affected by wide temperature swings in short periods of time. Because of this, the jet stream, which tends to weaken during the summer months, begins to re-strengthen. This leads to quicker changes in weather patterns and increasingly strong storm systems.[63][64] As autumn moves on, these storm systems bring with them progressively colder air, eventually changing the rain over snow, generally starting in October in the northern part of the state and November in the south.[65]

By late October and November atmospheric dynamics are generally in place to allow storm systems to become very intense. In fact, Minnesota's all time record low pressure was recorded during fall on November 10, 1998.[5] If these powerful storm systems are able to draw enough cold air southward from Canada, they can evolve into powerful blizzards. Some of Minnesota's most memorable winter storm events have occurred during the middle part of the fall season. On November 11, 1940, the southeast half of Minnesota was surprised by the Armistice Day Blizzard. Temperatures in the 60s °F (16 °C) on the morning of November 11 dropped into the single digits (below –12 °C) by the morning of November 12, bringing with them 27 inches (69 cm) of snow and 60 mph (100 km/h) winds. 154 people died in this blizzard, 49 of them in Minnesota.[66][67] On October 31, 1991, much of Minnesota was hit by the Halloween Blizzard. A band of snowfall of 24+ in (60+ cm) fell from the Twin Cities north to Duluth. It was the single largest snow storm ever recorded in many communities across eastern Minnesota.[68]

Blue skies and bright leaves during a Minnesota autumn.

Image and popular culture

Minnesota's climate has done much to shape the image of the state. Minnesotans boast of their "theater of seasons", with a late but intense spring, a summer of water sports, a fall of brilliantly colored leaves, and a long winter with outdoor sports and activities.

"Summer at the lake" is a Minnesota tradition. Water skiing was invented in Minnesota by Ralph Samuelson, and the Minneapolis Aquatennial features a milk carton boat race. Contestants build boats from milk cartons and float them on Minneapolis area lakes, with recognition based more on colorful and imaginative designs than on actual racing performance.[69]

But while Minnesota's warm summers provide its natives and tourists with a variety of outdoor activities, the state is known for its winters. The state has produced curlers and skiers who have competed in the Winter Olympics, pioneers who invented the snowmobile, and legions of ice fishing enthusiasts.[70]

The ice castle at the 2004 St. Paul Winter Carnival.

Ice fishing in Minnesota has been a theme in Hollywood films.

The state is also known for enthusiastic ice hockey players, both at the amateur and professional levels. Eveleth, Minnesota, home to the United States Hockey Hall of Fame, boasts of the number of quality players and the contributions of the city (and the rest of the Mesabi Range) to the growth and development of hockey in the United States.[71]

To many outsiders, Minnesota's winters appear to be cold and inhospitable. A World War II newscaster, in describing the brutally cold conditions of the Russian front, stated that at least Minnesotans could understand it.[70] A New York journalist visited St. Paul and declared that the city was "another Siberia, unfit for human habitation." In response, the city decided to build a huge ice palace in 1886, similar to one that Montreal had built in 1885. They hired the architects of the Canadian ice palace to design one for St. Paul and built a palace 106 ft (32.3 m) high with ice blocks cut from a nearby lake.[69] This began the tradition of the Saint Paul Winter Carnival, a ten day festival which celebrates Minnesota's winter season.[72]

Minnesota's winters are the setting of several Hollywood films, including the ice fishing comedies of *Grumpy Old Men* and *Grumpier Old Men*, set and filmed in the state.[73][74] The 1996 film noir *Fargo* also features the backdrop of a Minnesota winter, but like most of the characters in the movie, the climate is portrayed as bleak and inhospitable.[75]

Summer resorts on Minnesota's "10,000 lakes" may prefer to emphasize warm-season activities, but from *The Rocky and Bullwinkle Show's* Frostbite Falls, Minnesota to *Fargo*, long and cold winters seem to be the popular image of the climate of Minnesota.

See also

- Climate of the United States
- Meteorology
- Weather lore

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External links

- Minnesota State Climatology Office (http://climate.umn.edu/)

- National Weather Service - Central Region Headquarters (http://www.crh.noaa.gov/crh/)
- National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html)

RED WING DAM 3, MINNESOTA (216822)

Period of Record Monthly Climate Summary

Period of Record : 7/ 1/1948 to 6/30/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	23.5	29.3	41.4	56.7	68.4	77.9	82.4	79.8	72.4	59.0	41.5	29.0	55.1
Average Min. Temperature (F)	5.7	10.3	22.9	36.7	47.9	57.7	62.2	59.8	51.2	38.7	25.9	13.4	36.0
Average Total Precipitation (in.)	0.79	0.69	1.76	2.66	3.53	4.29	4.16	3.77	3.32	2.08	1.55	0.90	29.49
Average Total SnowFall (in.)	9.1	7.4	8.8	1.7	0.0	0.0	0.0	0.0	0.0	0.1	4.1	8.1	39.3
Average Snow Depth (in.)	6	8	5	0	0	0	0	0	0	0	1	3	2

Percent of possible observations for period of record:

Max. Temp.: 22.7% Min. Temp.: 22.7% Precipitation: 98.9% Snowfall: 96.9% Snow Depth: 95.4%
Check Station Metadata or Metadata graphics for more detail about data completeness.

High Plains Regional Climate Center, contact us.

GRAPHICAL CLIMATOLOGY OF MINNEAPOLIS-ST. PAUL AREA TEMPERATURES, PRECIPITATION, AND SNOWFALL

(1820-PRESENT)

By Charles Fisk* Last Update: 4 August 2008

The following is a graphical climatology of Minneapolis-St. Paul, Minnesota temperatures, precipitation, and snowfall, from the start of 1820 (Fort Snelling) into the present year 2008. Presented are 31 summary overview charts, a link to a year-by-year account of early (1820-1869) Minnesota weather history, followed by 188 year-to-year graphs depicting daily temperatures, precipitation, and snowfall. Original source data are from Fort Snelling (1820-1858), St. Paul Smithsonian recordings (1859-1872); and government weather service observations for St. Paul (1873-1890), downtown Minneapolis (1890-1938), and the Minneapolis-St. Paul International Airport (1938-present). Daily snowfall totals date from 1891, snow depth data from 1893.

Data were obtained from the National Archives, the Minnesota Historical Society, The University of Minnesota Periodicals Library, the National Climatic Data Center, the Minneapolis-St. Paul National Weather Service Office online site, and the Minnesota Climatology Working Group. Monthly updates are from the site: http://climate.umn.edu/doc/prelim_lcd_msp.htm

CLIMATE OVERVIEW GRAPHS –

TEMPERATURE:

MINNEAPOLIS-ST. PAUL DAILY TEMPERATURES (MEANS & EXTREMES)

COMPLETE YEAR JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

MINNEAPOLIS-ST. PAUL MONTHLY TEMPERATURES (EXTREMES): HIGHEST MAXIMA LOWEST MINIMA LOWEST MAXIMA HIGHEST MINIMA

MINNEAPOLIS-ST. PAUL AVERAGE DAY-TO-DAY VARIABILITY IN MEAN, MAX, & MIN TEMPERATURE, BY CALENDAR DAY

MINNEAPOLIS-ST. PAUL AVERAGE DAILY TEMPERATURE RANGES, BY CALENDAR DAY

MINNEAPOLIS-ST. PAUL STANDARD DEVIATION STATISTICS FOR DAILY MEAN, MAX, & MIN TEMPERATURES, BY CALENDAR DAY

MINNEAPOLIS-ST. PAUL SKEWNESS STATISTICS FOR DAILY MEAN, MAX, & MIN TEMPERATURES, BY CALENDAR DAY

MINNEAPOLIS-ST. PAUL ANNUAL MEAN TEMPERATURE HISTORY (1820-2007)

PRECIPITATION:

MINNEAPOLIS-ST. PAUL YEARLY PRECIPITATION HISTORY (1891-2007)

MINNEAPOLIS-ST. PAUL AVERAGE MONTHLY PRECIPITATION

MINNEAPOLIS-ST. PAUL PRCP-DAY FREQUENCIES FOR >=0.01", >=0.13", >=0.25", >=0.50", & >=1.00" MAGNITUDES, BY CALENDAR DAY (1891-2007)

MINNEAPOLIS-ST. PAUL MONTHLY PRECIPITATION DISTRIBUTIONS (BOXPLOTS)

SNOWFALL:

MINNEAPOLIS-ST. PAUL SEASONAL SNOWFALL HISTORY (1884-85 THRU 2007-08 SEASONS)

MINNEAPOLIS-ST. PAUL AVERAGE MONTHLY SNOWFALL

MINNEAPOLIS-ST. PAUL MONTHLY SNOWFALL DISTRIBUTIONS (BOXPLOTS)
MINNEAPOLIS-ST. PAUL ONE AND THREE-INCH SNOW-DAY PROBABILITIES, BY CALENDAR DAY
MINNEAPOLIS-ST. PAUL MEDIAN, MEAN, AND EXTREME MAXIMUM SNOW DEPTHS, BY CALENDAR DAY

YEAR-BY-YEAR ENCYCLOPAEDIC ACCOUNT OF EARLY MINNESOTA WEATHER (1820-1869)

THE HISTORICAL TEMPERATURE DATA: OFFICIAL WEATHER BUREAU OBSERVATIONS (1873-PRESENT) AND RECONSTRUCTED PIONEER ERA RECORDINGS (1820-1872)

Temperature graphs for the 1873-present period are based on official St. Paul or Minneapolis absolute maximum and minimum temperature observations for given days (nearly all for the midnight-to-midnight period), the standard method of recording "summary-of-the-day" temperature statistics for first-order weather stations.

Original summary-of-the-day temperature observations for the 1820-1872 "Pioneer" era (along with those for cloudiness, wind direction, and wind force), however, consisted of fixed-time scheme observations according to a prescribed format (e.g., 7AM, 2PM, and 9PM; or Sunrise, 9AM, 3PM, and 9PM) (example 1) (example 2).

To achieve methodological consistency, the fixed-time-scheme 1820-1872 observations were converted into midnight-to-midnight maxima and minima *approximations*, using application of 1961-1980 statistical relationships between Minneapolis-St. Paul Airport temperature, cloudiness, and wind information at hours corresponding to the old fixed-time schemes, and 1961-1980 midnight to midnight daily temperature maxima and minima [Fisk, 1984]. This reconstruction "homogenized" the entire history as to summary-of-the-day method, and affords identical-type daily temperature graphs to be presented here for the entire 1820-present history **ADD'L DETAILS ON RECONSTRUCTION OF MINNEAPOLIS-ST. PAUL AREA PIONEER-ERA TEMPERATURE RECORD**.

YEAR-TO-YEAR GRAPHS - INTERPRETATION

The uppermost chart on a given yearly page (links below) are "floating-bars" of the daily maxima and minima. Superimposed are two line traces, the upper one connecting average daily maxima, the lower one average daily minima. The bars depict the varying diurnal, synoptic, long-wave, and seasonal influences on temperature over time, and subjectively, some years' patterns can be quite interesting to look at (see "REPEAT LINKS TO SOME OF THE MORE INTERESTING YEARS WITH ACCOMPANYING NOTES" section below).

The second chart down shows the arithmetic departures of day-to-day mean temperatures (sum of the daily maximum plus the daily minimum divided by two) less the corresponding calendar-day average means. Vertical lines extending upward from the zero line indicate above average means for the day (colored red), those extending downward indicate below average daily means (colored blue). In the entire series of more than 68,000 days, greatest positive departure for any individual day is +38 F for 25 January 1944, the greatest negative departure -45 F for 1 January 1864.

1820 1821 1822 1823 1824 1825 1826 1827 1828 1829 1830 1831 1832 1833 1834
1835 1836 1837 1838 1839
1840 1841 1842 1843 1844 1845 1846 1847 1848 1849 1850 1851 1852 1853 1854
1855 1856 1857 1858 1859
1860 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871 1872 1873 1874
1875 1876 1877 1878 1879
1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894
1895 1896 1897 1898 1899
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1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954
1955 1956 1957 1958 1959
1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974
1975 1976 1977 1978 1979
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
1995 1996 1997 1998 1999
2000 2001 2002 2003 2004 2005 2006 2007 2008

The third chart down shows chart two's departures in deseasonalized or "standardized" form. This adjusts for the fact that individual calendar days have higher or lower inherent year-to-year variability in daily mean temperature. For example, standard deviations of given calendar-day daily mean temperatures for the 1820-2006 period ranged from 14.87 F (4 February) to 5.48 F (21 August). Dividing a given day's departure from average by its' respective calendar day daily mean temperature standard deviation creates the standardized departures or "z-scores". Only five daily departures in the entire series are plus or minus 3.5 or greater. Three of these, all negatives, came over the four-day period 4-7 November 1991, associated with an unseasonably cold arctic air outbreak in the wake of a record early and heavy snowstorm.

The fourth chart down depicts daily rainfall, the fifth and sixth charts, respectively, daily snowfall and snow depths.

REPEAT LINKS TO SOME OF THE MORE INTERESTING YEAR-TO-YEAR GRAPHS, WITH ACCOMPANYING NOTES

1820 - Year One. Frigid January **WEATHER DIARY FOR JAN 1820**, very mild April, eleven-inch snowstorm in mid-October.

1822 - Coldest December in history **DEC 1822**; December 2nd 42 F below average. Also torrential June rains, producing local flooding **JUN 1822**.

1824-1825 - (July-June view). Exceptionally mild December '24 to April '25 period; likely El Nino influence.

1826 - Very backward April **APR 1826** (accompanied by severe flooding), but May 28 F warmer than April.

1829 - "The Dry Year", as described by early Minnesota history texts. Severely cold February and other extreme temperature spells throughout year.

1830 - Hottest July until 1936, and much above normal October/November.

1833 - El Nino winter of '32-'33 mildest for another 45 years. Very mild December '33 also.

1833-34 - (July-June view). Greatest three-month thermal "see-saw" in history: January 1834 29 F colder than December 1833, February 1834 28 F warmer than January.

1835 - Volcanic dust-veil produces series of anomalous cold spells during second half.

1838 - Great temperature extremes. Minus 40 F in February and a late May hard freeze. Hot summer, but unseasonable cold in fall and early winter.

1838-39 - (July-June view). Abnormal cold over October to December '38 gives way to abnormal warmth over January to April '39.

1839 - Warmest recorded year up to this time; warmest April **APR 1839** down to the present day.

1842 - Extraordinary coolness over mid-May into July. Coldest June **JUN 1842** and coldest November **NOV 1842** in all history down to present.

1843 - Coldest year in area **history**. Extraordinary persistent arctic cold over February and March. Coldest March (more than 25 F below average) **MAR 1843**, and coldest October **OCT 1843** in all history down to present.

1842-43 - (July-June view).

1845 - Steep temperature plunge over mid-to-late November.

1846 - Warmest year of pre-statehood era. Mildest January in all history down to the present **JAN 1846**.

1849 - December 34 F colder than November.

1855-56 - Two successive arctic blasts, in late December **DEC 1855** and early January **JAN 1856.** A third in February.

1857 - Second successive bitter winter. Coldest January **JAN 1857** and April **APR 1857** in history.

1863 - The "Strange" weather year. Extremes in temperatures, and worst growing season drought to date - no measurable rain in June (St. Paul). Killing frosts in July and August across settled areas.

1864 - Continued drought during the year. Frigid New Years' Day - Maximum: -24 F, Minimum: -38 F in St. Paul.

1865 - Heavy summer rains break drought; 38" recorded for year in St. Paul, more than '63 and '64 combined. Very cool summer, July 1 F cooler than September.

1867 - Very backward spring. March 1867 5 F colder than any March since, but still 8 F warmer than 1843. More than 10" rain in June in St. Paul.

1869 - More than 18" rain over August and September.

1875 - Second coldest year in **history**. January and February both AVERAGE below zero.

1877-78 - "Year Without a Winter". El Nino-induced extraordinarily mild winter. Mildest December in history. Near record warmest February and March.

1879 - "Second Edition of Summer" brings unseasonable October warmth. Very cold Christmas Day, minus 39 recorded in St. Paul.

1885 - Great temperature variability over January to March.

1888 - Severe winter (including -41 F in January). Persistent spells of unseasonable coolness into spring and summer.

1895 - Abrupt May cold turn temporarily derails an otherwise forward Spring.

1899 - Great February cold wave.

1907 - Persistent abnormal cold through April and May; 13" snowstorm over Apr 27-28.

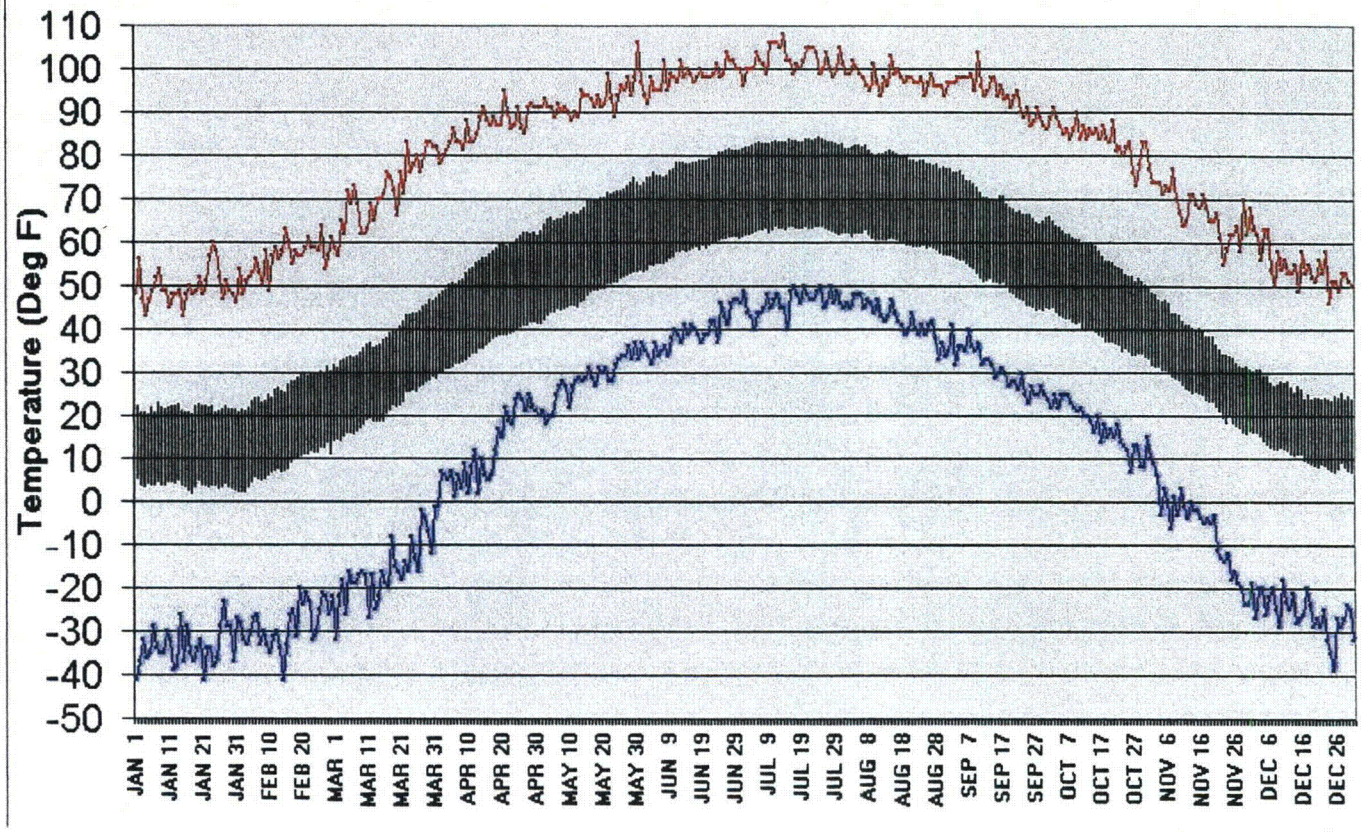
1910 - Driest year (11.54") in local climatic history down to present. Also warmest March in all history.

1911 - Great adjacent-year reversal in annual precipitation - *Wettest* year (40.15") in all history down to present.

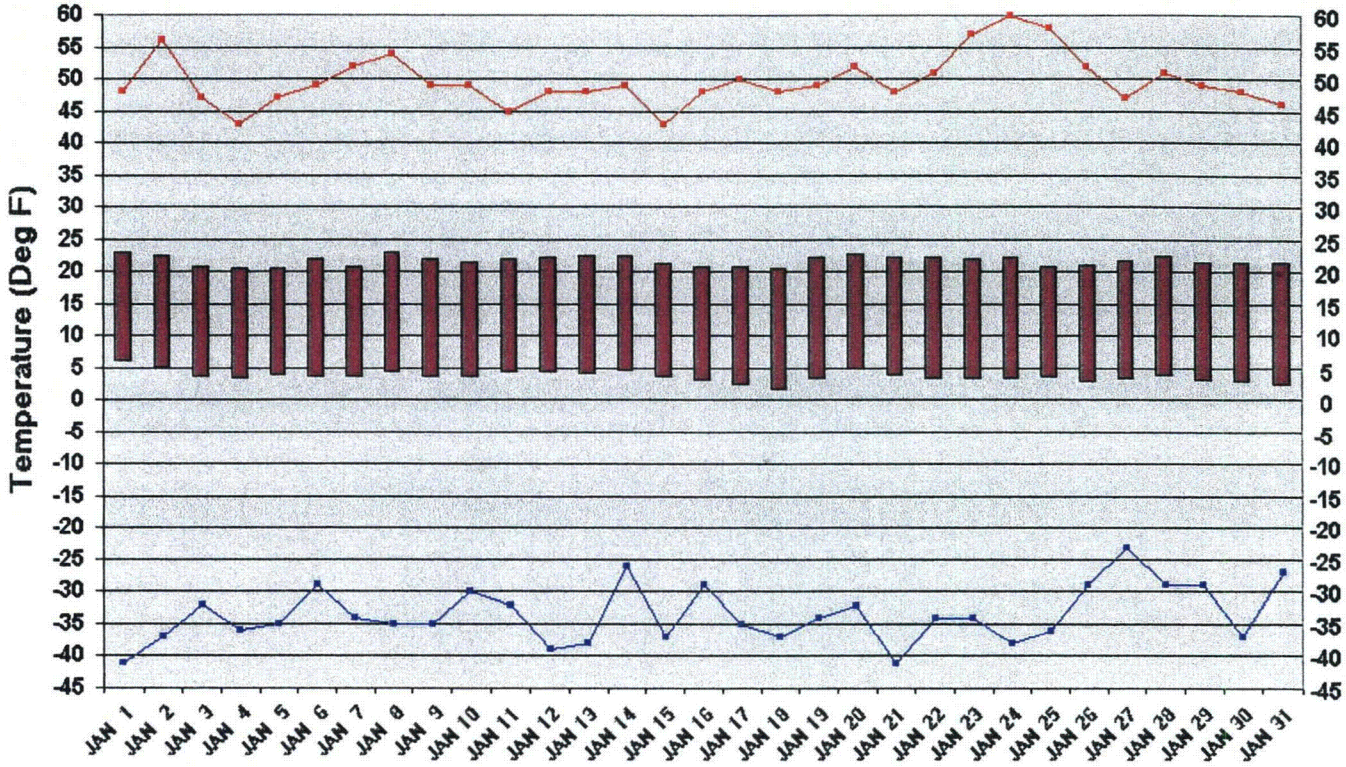
1915 - Very forward April, but May 4 F colder; very cool summer ensues.

1917

AVERAGE AND RECORD DAILY MAXIMUM AND MINIMUM TEMPERATURES, MINNEAPOLIS- ST. PAUL, MN (1820-2006 PERIOD of RECORD)



AVERAGE AND RECORD DAILY MAXIMUM AND MINIMUM TEMPERATURES, FOR JANUARY - MPLS.-ST. PAUL (1820-2006 PERIOD OF RECORD)



122 years of Twin Cities Monthly and Seasonal Snowfall Totals (inches)
1884 - 2008

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Season Total
Downtown St. Paul													
84-85	0.0	0.0	0.0	1.1	7.2	14.9	3.5	2.0	4.0	8.3	1.0	0.0	42.0
85-86	0.0	0.0	0.0	0.2	0.5	3.5	14.7	2.8	10.4	0.1	0.0	0.0	32.2
86-87	0.0	0.0	0.0	0.0	19.6	5.7	21.6	6.9	1.7	1.0	0.0	0.0	56.5
87-88	0.0	0.0	0.0	0.2	1.7	15.4	4.5	3.4	11.9	0.2	1.0	0.0	38.3
88-89	0.0	0.0	0.0	0.5	2.1	2.2	2.6	3.9	4.1	T	0.0	0.0	15.4
89-90	0.0	0.0	T	0.0	4.0	5.5	8.3	4.4	7.5	T	2.0	0.0	31.7
90-91	0.0	0.0	0.0	T	4.4	2.3	4.7	12.3	6.2	3.2	T	0.0	33.1
Downtown Minneapolis													
91-92	0.0	0.0	0.0	0.0	8.8	5.8	0.6	7.2	7.3	T	3.0	0.0	32.7
92-93	0.0	0.0	0.0	0.0	3.5	6.3	11.4	17.8	7.1	13.0	T	0.0	59.1
93-94	0.0	0.0	0.0	0.0	8.2	12.4	12.0	0.3	11.2	5.8	0.0	0.0	49.9
94-95	0.0	0.0	0.0	T	0.8	2.7	9.0	3.3	0.4	0.0	0.0	0.0	16.2
95-96	0.0	0.0	0.0	0.4	2.6	0.6	5.2	2.2	8.6	7.4	0.0	0.0	27.0
96-97	0.0	0.0	0.0	T	8.8	4.2	13.6	10.3	16.0	0.5	0.0	0.0	53.4
97-98	0.0	0.0	0.0	0.0	4.8	1.5	0.6	9.6	12.7	2.1	0.0	0.0	31.3
98-99	0.0	0.0	0.0	T	14.1	1.5	8.0	15.2	23.6	T	0.0	0.0	62.4
99-00	0.0	0.0	0.0	0.1	1.0	1.9	6.1	9.1	16.7	1.5	0.0	0.0	36.4
00-01	0.0	0.0	0.0	0.0	7.8	4.3	5.8	4.5	19.1	T	0.0	0.0	41.5
01-02	0.0	0.0	0.0	0.0	3.2	7.2	5.3	4.4	1.5	0.8	T	0.0	22.4
02-03	0.0	0.0	0.0	0.0	2.4	24.0	4.2	2.6	4.1	1.5	T	0.0	38.8
03-04	0.0	0.0	0.0	0.0	2.5	8.3	8.5	13.2	5.8	7.8	0.0	0.0	46.1
04-05	0.0	0.0	0.0	T	0.3	7.4	13.1	9.3	1.0	T	T	0.0	31.1
05-06	0.0	0.0	0.0	5.5	11.5	1.9	17.7	4.5	4.0	T	0.1	0.0	45.2
06-07	0.0	0.0	0.0	T	3.0	8.6	12.8	11.6	5.8	13.0	0.8	0.0	55.6
07-08	0.0	0.0	0.0	0.0	0.3	7.3	8.0	10.6	14.3	11.7	T	0.0	52.2
08-09	0.0	0.0	T	0.0	0.3	13.5	12.7	24.2	3.7	8.5	1.8	0.0	64.7
09-10	0.0	0.0	0.0	T	11.0	19.2	14.1	6.1	0.9	4.9	0.0	0.0	56.2
10-11	0.0	0.0	0.0	0.1	3.9	4.2	10.1	5.9	4.6	8.7	0.0	0.0	37.5
11-12	0.0	0.0	0.0	T	12.1	14.4	8.4	2.7	4.6	0.5	0.0	0.0	42.7
12-13	0.0	0.0	0.0	T	1.0	13.6	4.5	11.7	11.6	5.0	0.0	0.0	47.4
13-14	0.0	0.0	0.0	1.1	0.6	T	7.7	6.8	2.9	3.4	0.0	0.0	22.5
14-15	0.0	0.0	0.0	0.0	0.4	8.4	16.4	6.4	14.3	0.0	2.0	0.0	47.9
15-16	0.0	0.0	0.0	T	5.1	7.6	23.9	7.3	5.6	1.2	T	0.0	50.7
16-17	0.0	0.0	T	4.3	0.1	13.6	28.8	7.7	29.9	0.5	0.0	0.0	84.9
17-18	0.0	0.0	0.0	2.3	0.9	6.2	5.3	4.9	11.2	T	0.0	0.0	30.8
18-19	0.0	0.0	0.0	T	0.5	4.8	4.6	11.8	1.5	2.2	0.0	0.0	25.4
19-20	0.0	0.0	0.0	2.6	11.0	8.0	18.5	5.0	14.3	5.5	0.0	0.0	64.9
20-21	0.0	0.0	0.0	T	1.1	9.4	3.4	5.6	1.0	0.1	T	0.0	20.6
21-22	0.0	0.0	0.0	T	16.6	3.2	7.0	13.6	1.4	1.5	0.0	0.0	43.3
22-23	0.0	0.0	0.0	0.4	0.8	1.7	11.8	4.2	11.8	11.0	0.5	0.0	42.2
23-24	0.0	0.0	0.0	T	1.4	2.7	7.7	5.5	12.6	2.0	0.5	0.0	32.4
24-25	0.0	0.0	0.0	0.0	3.2	10.0	5.4	4.2	0.3	0.0	0.1	0.0	23.2
25-26	0.0	0.0	0.0	3.3	3.6	3.2	7.9	5.5	10.7	2.8	0.0	0.0	37.0
26-27	0.0	0.0	0.0	0.1	4.9	12.3	5.5	2.1	4.1	1.1	T	0.0	30.1
27-28	0.0	0.0	T	0.0	5.3	22.8	3.2	3.2	5.7	16.9	0.0	0.0	57.1
28-29	0.0	0.0	T	0.0	T	3.6	18.3	11.7	4.4	9.2	0.2	0.0	47.4
29-30	0.0	0.0	0.0	1.9	2.7	5.3	11.0	4.8	1.8	0.0	0.0	0.0	27.5
30-31	0.0	0.0	0.0	0.5	4.7	0.7	0.9	7.0	0.4	T	T	0.0	14.2
31-32	0.0	0.0	0.0	0.0	0.7	3.5	18.7	8.1	13.4	2.2	0.0	0.0	46.6
32-33	0.0	0.0	0.0	1.6	0.8	13.7	4.1	8.9	4.7	0.9	0.0	0.0	34.7
33-34	0.0	0.0	0.0	0.3	5.7	5.1	6.1	2.1	5.9	0.4	0.0	0.0	25.6
34-35	0.0	0.0	0.0	T	8.5	13.0	14.8	0.8	4.6	6.9	3.0	0.0	51.6
35-36	0.0	0.0	0.0	T	2.6	8.3	9.1	19.7	16.5	2.6	0.0	0.0	58.8
36-37	0.0	0.0	0.0	0.1	1.7	11.2	12.2	7.6	8.2	3.6	0.0	0.0	44.6
37-38	0.0	0.0	0.0	T	1.2	5.4	9.3	7.4	6.2	T	T	0.0	29.5
Twin Cities International Airport													
38-39	0.0	0.0	0.0	1.9	0.5	9.1	7.4	11.9	6.0	4.8	0.0	0.0	41.6
39-40	0.0	0.0	0.0	0.6	T	4.8	5.0	9.1	25.6	T	T	0.0	45.1
40-41	0.0	0.0	0.0	0.0	26.3	10.6	3.3	5.5	6.8	T	0.0	0.0	52.5
41-42	0.0	0.0	0.0	T	3.8	8.6	1.7	5.2	4.6	T	0.0	0.0	23.9

42-43	0.0	0.0	1.7	0.3	0.9	7.0	10.1	4.6	9.8	T	T	0.0	34.4
43-44	0.0	0.0	0.0	T	10.3	T	1.0	4.2	11.1	0.3	T	0.0	26.9
44-45	0.0	0.0	0.0	0.0	2.5	1.1	8.2	15.4	0.7	6.0	T	0.0	33.9
45-46	0.0	0.0	T	0.0	4.5	14.6	4.3	11.9	1.5	0.1	3.0	0.0	39.9
46-47	0.0	0.0	0.0	T	4.1	5.9	7.6	1.9	3.3	2.0	0.2	0.0	25.0
47-48	0.0	0.0	0.0	0.0	21.8	6.7	3.5	11.6	5.2	0.3	T	0.0	49.1
48-49	0.0	0.0	0.0	T	2.5	2.3	12.5	3.4	8.3	9.3	0.0	0.0	38.3
49-50	0.0	0.0	0.0	T	2.7	6.5	17.0	7.9	11.1	6.4	0.0	0.0	51.6
50-51	0.0	0.0	0.0	0.0	5.6	25.0	7.1	8.6	40.0	2.6	0.0	0.0	88.9
51-52	0.0	0.0	0.0	0.8	10.8	16.5	9.9	15.0	25.4	0.6	0.0	0.0	79.0
52-53	0.0	0.0	0.0	0.0	10.1	6.0	6.0	13.4	6.7	0.7	0.0	0.0	42.9
53-54	0.0	0.0	0.0	0.0	1.9	5.9	3.6	1.0	10.7	0.2	2.4	0.0	25.7
54-55	0.0	0.0	0.0	0.4	6.4	4.0	7.8	11.0	4.3	0.0	0.0	0.0	33.9
55-56	0.0	0.0	0.0	2.5	6.0	14.6	4.6	2.4	14.0	1.1	0.0	0.0	45.2
56-57	0.0	0.0	0.0	0.0	6.8	2.1	4.9	8.7	7.0	9.6	0.0	0.0	39.1
57-58	0.0	0.0	0.0	0.0	10.3	2.2	2.4	1.2	3.5	1.6	0.0	0.0	21.2
58-59	0.0	0.0	0.0	0.0	3.3	2.4	1.4	6.3	5.7	0.0	0.0	0.0	19.1
59-60	0.0	0.0	0.0	3.7	6.9	3.5	9.5	2.7	5.5	0.0	0.0	0.0	31.8
60-61	0.0	0.0	0.0	0.0	2.4	1.7	4.6	8.7	15.1	7.7	0.0	0.0	40.2
61-62	0.0	0.0	0.1	0.0	2.5	18.1	5.9	26.5	21.8	6.4	0.0	0.0	81.3
62-63	0.0	0.0	0.0	0.0	5.6	3.2	5.0	5.4	9.8	5.5	0.0	0.0	34.5
63-64	0.0	0.0	0.0	0.0	0.0	7.6	5.0	1.0	9.7	5.6	0.0	0.0	28.9
64-65	0.0	0.0	0.0	0.0	4.3	8.1	10.5	11.7	37.1	2.0	0.0	0.0	73.7
65-66	0.0	0.0	0.0	0.0	1.6	1.2	11.9	6.8	14.2	0.4	0.0	0.0	36.1
66-67	0.0	0.0	0.0	0.2	3.4	12.7	35.3	23.7	2.6	0.2	0.3	0.0	78.4
67-68	0.0	0.0	0.0	0.3	0.8	2.4	10.6	2.2	0.8	0.4	0.0	0.0	17.5
68-69	0.0	0.0	0.0	0.0	4.9	28.7	21.6	5.3	7.3	0.3	0.0	0.0	68.1
69-70	0.0	0.0	0.0	2.4	3.8	33.2	9.8	4.3	8.6	1.3	0.0	0.0	63.4
70-71	0.0	0.0	0.0	0.0	6.3	5.5	19.9	13.9	7.0	1.9	0.2	0.0	54.7
71-72	0.0	0.0	0.0	0.0	13.2	12.8	12.2	7.6	10.4	8.0	0.0	0.0	64.2
72-73	0.0	0.0	0.0	0.0	1.1	15.3	11.6	11.3	0.4	2.0	0.0	0.0	41.7
73-74	0.0	0.0	0.0	0.0	0.1	17.9	2.5	15.7	7.7	7.3	0.0	0.0	51.2
74-75	0.0	0.0	0.0	0.0	1.2	6.1	27.4	9.0	18.3	2.2	0.0	0.0	64.2
75-76	0.0	0.0	0.0	0.0	16.2	5.6	12.8	5.1	13.6	0.0	1.2	0.0	54.5
76-77	0.0	0.0	0.0	2.3	1.4	8.3	13.4	1.8	14.6	1.8	0.0	0.0	43.6
77-78	0.0	0.0	0.0	3.0	11.7	14.2	6.8	4.6	8.5	1.9	0.0	0.0	50.7
78-79	0.0	0.0	0.0	0.0	16.5	15.1	14.2	13.5	8.4	0.7	0.0	0.0	68.4
79-80	0.0	0.0	0.0	0.0	7.7	1.7	12.9	8.8	13.7	8.5	0.0	0.0	53.3
80-81	0.0	0.0	0.0	0.0	0.9	2.8	4.6	11.0	0.1	1.7	0.0	0.0	21.1
81-82	0.0	0.0	0.0	0.9	14.0	10.6	46.4	7.4	10.9	4.8	0.0	0.0	95.0
82-83	0.0	0.0	0.0	1.4	3.6	19.3	3.2	10.8	14.3	21.8	0.0	0.0	74.4
83-84	0.0	0.0	0.0	0.0	30.4	21.0	10.8	9.3	17.3	9.8	0.0	0.0	98.6
84-85	0.0	0.0	0.0	0.3	2.0	16.3	13.1	4.2	36.8	T	0.0	0.0	72.7
85-86	0.0	0.0	0.4	0.0	23.9	13.5	10.3	12.3	8.7	0.4	0.0	0.0	69.5
86-87	0.0	0.0	0.0	0.0	4.4	4.2	5.5	1.2	2.1	T	0.0	0.0	17.4
87-88	0.0	0.0	0.0	0.3	4.5	7.5	19.5	4.5	3.7	2.4	0.0	0.0	42.4
88-89	0.0	0.0	0.0	0.2	15.8	7.2	6.0	17.3	22.7	0.8	0.1	0.0	70.1
89-90	0.0	0.0	0.0	0.0	11.3	7.0	1.1	10.7	3.2	2.2	0.0	0.0	35.5
90-91	0.0	0.0	0.0	0.0	5.0	11.7	6.5	14.2	4.4	1.5	0.3	0.0	43.6
91-92	0.0	0.0	0.0	8.2	46.9	6.7	5.0	5.9	10.8	0.6	0.0	0.0	84.1
92-93	0.0	0.0	0.0	1.3	12.2	9.2	12.0	5.3	6.9	0.5	0.0	0.0	47.4
93-94	0.0	0.0	0.0	0.0	7.7	4.5	24.3	12.0	1.7	5.5	0.0	0.0	55.7
94-95	0.0	0.0	0.0	0.0	6.2	6.5	4.2	2.1	10.4	0.2	0.0	0.0	29.6
95-96	0.0	0.0	0.0	0.7	6.6	16.1	14.5	1.2	14.1	2.3	T	0.0	55.5
96-97	0.0	0.0	0.0	T	15.3	23.7	14.2	4.0	14.3	0.6	T	0.0	72.1
97-98	0.0	0.0	0.0	T	8.6	3.3	20.4	1.1	11.6	T	T	0.0	45.0
98-99	0.0	0.0	0.0	0.0	0.1	3.1	33.1	4.2	16.0	T	0.0	0.0	56.5
99-00	0.0	0.0	0.0	T	0.7	7.3	18.2	7.7	1.0	1.3	0.0	0.0	36.2
Chanhassen													
00-01	0.0	0.0	0.0	T	9.8	30.2	9.4	16.5	8.6	1.3	T	0.0	75.8
01-02	0.0	0.0	0.0	0.1	9.4	8.0	9.5	3.1	15.7	20.2	0.0	0.0	66.0
02-03	0.0	0.0	0.0	0.6	1.4	3.0	5.1	10.7	13.2	1.0	0.0	0.0	35.0
03-04	0.0	0.0	0.0	T	9.4	16.1	10.7	19.7	10.4	T	0.0	0.0	66.3
Twin Cities International Airport													
04-05	0.0	0.0	0.0	T	0.5	1.8	8.6	8.0	6.6	T	T	0.0	25.5
05-06	0.0	0.0	0.0	T	5.1	14.5	2.3	2.1	20.4	0.0	0.0	0.0	44.4
06-07	0.0	0.0	0.0	T	0.2	4.3	5.5	12.6	11.0	1.9	0.0	0.0	35.5

07-08	0.0	0.0	0.0	0.0	0.4	18.1	2.0	4.8	18.0	1.3			44.6 (as of April 14)
Average (122 years)	0.0	0.0	0.0	0.6	6.2	8.8	10.0	7.8	9.4	3.6	0.2	0.0	45.8

Twin Cities Monthly and Yearly Precipitation Totals (inches)
1891 - 2007

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Downtown Minneapolis													
1891	0.97	1.67	1.42	2.42	1.27	3.44	2.99	3.18	1.75	1.67	0.87	3.16	24.81
1892	0.05	1.37	0.97	1.27	6.66	6.74	11.87	4.71	1.45	0.45	0.43	0.75	36.72
1893	0.87	1.58	2.09	5.21	2.50	1.83	1.66	6.30	2.86	1.67	1.15	2.41	30.13
1894	1.12	0.03	2.72	4.61	4.77	1.15	0.20	0.38	1.52	4.54	0.41	1.40	22.85
1895	0.88	0.42	0.44	1.68	2.90	3.67	4.37	1.92	4.26	0.05	0.70	0.15	21.44
1896	0.67	0.14	2.70	5.12	3.94	2.69	1.39	3.51	2.58	3.55	3.98	0.57	30.84
1897	1.66	1.03	3.05	1.48	1.87	9.00	4.27	1.94	1.64	1.67	0.70	0.13	28.44
1898	0.05	1.47	1.67	1.46	5.17	2.69	2.91	2.33	0.83	5.51	1.49	0.07	25.65
1899	0.77	0.87	2.40	0.57	3.36	6.03	1.54	3.16	1.31	3.17	0.38	1.37	24.93
1900	0.62	0.31	1.50	1.76	0.43	2.21	8.15	6.67	7.44	4.52	0.61	0.37	34.59
1901	0.31	0.26	1.84	1.58	1.57	6.25	1.64	2.65	3.80	0.94	1.00	0.46	22.30
1902	0.44	0.47	0.30	2.70	4.33	2.00	6.05	5.94	4.03	1.40	1.74	2.61	32.01
1903	0.22	0.50	2.05	3.02	4.40	1.02	7.29	4.61	7.77	4.36	0.31	0.64	36.19
1904	0.43	0.75	1.64	1.83	3.54	3.81	4.78	5.61	3.19	4.94	0.10	0.61	31.23
1905	0.71	0.59	0.73	0.74	4.47	7.11	3.02	4.32	6.50	2.17	3.07	0.06	33.49
1906	1.55	0.35	0.76	2.21	10.33	2.96	3.01	3.32	5.44	1.93	2.52	0.76	35.14
1907	0.93	0.76	0.56	1.37	2.01	3.64	4.20	5.58	4.26	1.26	0.76	0.58	25.91
1908	0.49	0.98	1.48	4.07	8.14	6.68	2.19	0.62	4.91	2.27	1.02	1.33	34.18
1909	1.37	2.14	0.40	2.23	3.85	2.68	5.03	2.09	2.98	2.05	2.74	2.38	29.94
1910	1.08	0.51	0.09	0.64	1.39	1.19	0.74	1.56	2.58	0.86	0.59	0.31	11.54
1911	0.71	0.89	1.25	2.55	4.10	6.93	4.62	3.65	5.83	6.42	1.25	1.95	40.15
1912	0.44	0.19	0.34	2.22	4.68	0.94	7.08	5.56	1.59	1.23	0.08	1.93	26.28
1913	0.42	0.74	1.65	1.86	2.86	2.21	7.75	1.40	4.27	2.55	0.48	0.05	26.24
1914	0.83	0.45	0.98	3.69	1.80	8.63	1.17	8.70	2.76	1.58	0.19	0.37	31.15
1915	1.37	2.01	0.93	1.87	3.98	4.91	5.92	3.49	2.57	2.59	3.62	0.46	33.72
1916	2.88	0.32	1.19	3.07	6.97	4.54	1.27	1.66	2.42	1.60	0.58	0.98	27.48
1917	1.57	0.43	2.74	1.70	4.24	3.77	4.06	2.83	2.16	1.70	0.06	0.41	25.67
1918	0.38	0.55	0.93	0.91	4.32	2.83	4.99	3.73	1.25	2.31	4.06	1.71	27.97
1919	0.43	2.02	0.84	3.44	1.71	4.04	6.19	1.88	1.47	1.69	2.73	0.68	27.12
1920	1.84	0.46	2.71	2.23	2.67	8.43	1.30	1.14	1.95	2.79	1.24	0.62	27.38
1921	0.44	0.51	2.21	2.04	3.49	3.81	3.16	2.03	3.99	0.37	1.58	0.26	23.89
1922	0.88	3.25	1.60	1.35	2.94	5.63	1.67	1.66	2.16	1.21	3.56	0.15	26.06
1923	1.01	0.53	1.08	1.99	2.97	5.04	3.12	1.98	1.61	1.19	0.45	0.41	21.38
1924	0.54	0.63	1.23	3.38	1.03	7.35	1.22	7.35	3.43	0.76	0.65	0.83	28.40
1925	0.46	0.41	0.44	1.21	2.66	4.76	4.03	0.20	3.35	0.58	0.53	0.78	19.41
1926	0.71	0.55	1.61	0.58	1.13	3.76	3.49	3.72	5.18	1.61	1.82	1.48	25.64
1927	0.54	0.35	2.43	2.48	3.22	6.77	1.86	2.11	4.32	2.30	1.50	2.31	30.19
1928	0.33	1.51	0.93	2.33	2.38	2.59	3.68	5.84	2.17	3.17	0.35	0.43	25.71
1929	1.60	1.05	1.31	1.62	1.91	4.21	3.33	2.15	3.57	2.17	0.36	0.36	23.64
1930	0.95	2.66	0.48	0.62	3.38	6.68	0.92	0.72	4.14	1.14	2.41	0.06	24.16
1931	0.13	0.70	1.49	1.20	1.35	4.78	1.12	2.97	2.42	1.87	3.29	0.71	22.03
1932	1.70	0.74	1.42	2.15	2.05	1.56	4.36	3.87	0.85	0.89	2.28	1.52	23.39
1933	0.89	0.77	2.15	1.43	7.87	1.31	2.16	1.09	3.44	1.26	0.57	0.63	23.57
1934	0.68	0.17	0.68	1.57	0.21	2.30	1.40	1.61	4.86	5.64	2.38	1.23	22.73
1935	1.44	0.21	1.63	2.32	3.81	4.82	2.59	3.02	1.98	3.95	0.69	1.04	27.50
1936	0.77	1.55	2.66	1.48	2.25	2.29	0.11	3.48	0.78	0.66	0.66	1.78	18.47
1937	1.24	0.48	1.07	2.62	5.42	3.11	0.48	4.10	1.67	1.36	0.51	0.53	22.59
1938	0.87	0.62	2.11										
At 1pm on April 9th, 1938 the official observation was transferred to The Twin Cities International Airport.													
				3.27	6.97	2.96	3.36	3.45	3.24	0.84	1.29	0.77	29.75
1939	1.06	0.88	0.61	2.19	3.55	4.95	2.75	3.65	2.31	1.56	0.02	0.97	24.50
1940	0.37	0.91	2.16	1.21	1.64	7.10	2.46	4.54	0.41	1.57	5.15	1.02	28.54
1941	0.74	0.89	0.77	1.87	2.91	3.29	1.98	3.66	3.47	5.52	1.05	0.85	27.00
1942	0.15	0.45	1.74	3.41	6.78	2.69	3.80	2.11	7.53	0.78	0.27	0.85	30.56
1943	0.91	0.57	0.81	0.98	4.27	4.23	3.78	1.75	2.47	1.30	1.64	0.00	22.71
1944	0.24	1.10	1.20	2.24	6.15	6.69	4.39	3.65	0.97	0.26	2.10	0.09	29.08
1945	0.63	1.84	1.95	2.95	3.09	5.57	4.13	2.27	2.13	0.30	0.93	1.41	27.20
1946	0.94	1.15	1.20	0.66	3.04	7.80	2.76	0.43	6.58	2.51	1.22	0.68	28.97
1947	0.71	0.20	0.47	2.44	2.57	5.30	0.96	2.41	1.48	1.10	2.85	0.60	21.09
1948	0.15	1.37	1.43	1.77	0.74	2.58	1.34	3.37	1.04	0.60	1.89	0.67	16.95

1949	1.65	0.14	3.37	1.89	0.90	2.74	6.01	2.64	2.67	1.72	0.42	0.99	25.14
1950	1.27	0.68	2.20	2.19	2.87	1.26	3.74	1.84	1.46	1.22	0.89	1.99	21.61
1951	0.44	1.71	3.00	1.86	4.14	5.50	5.44	1.94	5.80	1.34	2.12	1.21	34.50
1952	1.05	1.20	3.09	0.59	2.86	3.98	4.56	4.18	0.42	0.01	1.28	0.45	23.67
1953	0.55	1.23	1.22	2.04	1.92	7.10	6.81	2.75	0.55	0.15	1.54	1.76	27.62
1954	0.25	0.32	2.10	3.53	2.54	4.71	1.33	3.08	3.65	1.23	0.61	0.33	23.68
1955	0.47	1.54	0.52	0.92	0.69	1.53	7.10	2.15	0.99	2.21	1.04	1.26	20.42
1956	0.48	0.20	1.62	0.67	1.96	6.58	5.18	5.22	0.79	1.95	1.35	0.20	26.20
1957	0.32	0.83	1.31	1.23	3.13	4.12	6.31	5.75	1.65	1.40	1.56	0.24	27.85
1958	0.21	0.24	0.32	1.99	1.39	2.01	3.15	3.03	1.09	1.55	1.01	0.21	16.20
1959	0.11	0.61	0.59	0.64	5.03	4.07	2.60	6.60	2.29	2.43	0.63	1.28	26.88
1960	0.68	0.22	0.81	2.04	3.19	3.08	1.93	3.99	3.79	0.31	0.87	0.55	21.46
1961	0.28	0.89	2.81	2.39	3.48	1.87	2.94	2.38	3.01	3.03	1.06	1.60	25.74
1962	0.55	2.07	1.87	1.31	8.03	1.48	5.12	3.47	2.46	1.69	0.52	0.26	28.83
1963	0.46	0.41	1.18	2.07	5.06	1.91	1.53	1.55	3.47	0.81	0.52	0.60	19.57
1964	0.47	0.06	1.35	2.98	3.44	2.18	2.02	5.42	5.21	0.57	1.19	1.08	25.97
1965	0.47	1.59	4.75	3.52	7.86	4.01	4.69	4.04	4.90	0.90	1.98	1.23	39.94
1966	0.95	1.55	2.48	0.89	1.46	3.51	2.47	4.40	1.69	3.53	0.39	1.02	24.34
1967	3.63	1.59	0.96	4.07	0.61	7.53	1.36	2.79	0.63	1.73	0.09	0.45	25.44
1968	0.71	0.13	1.89	2.94	3.74	6.78	6.46	0.75	6.16	5.62	0.54	2.21	37.93
1969	2.05	0.31	0.90	1.55	1.98	2.93	2.95	0.99	0.49	2.53	0.55	2.06	19.29
1970	0.47	0.16	2.05	3.55	4.77	1.27	3.66	2.19	3.19	4.97	3.82	0.43	30.53
1971	1.22	1.74	1.21	1.11	3.14	3.52	3.94	1.78	2.73	5.68	2.67	0.70	29.44
1972	0.84	0.49	1.25	1.69	2.18	3.31	5.12	2.48	1.96	1.77	1.11	1.57	23.77
1973	0.92	0.84	1.12	2.32	2.48	1.06	2.90	3.05	2.08	1.29	1.97	1.10	21.13
1974	0.17	1.06	1.00	2.42	2.08	5.21	1.14	2.75	0.58	1.69	0.66	0.35	19.11
1975	2.82	0.79	1.67	5.40	3.81	7.99	0.58	4.92	1.31	0.27	4.80	0.79	35.15
1976	0.87	0.59	2.83	0.80	1.13	3.86	2.45	1.39	1.42	0.49	0.16	0.51	16.50
1977	0.65	0.93	2.66	1.84	2.86	3.57	3.72	9.31	4.43	2.34	1.42	1.15	34.88
1978	0.38	0.24	0.79	3.63	3.79	7.09	3.19	5.77	2.47	0.19	1.84	0.88	30.26
1979	1.09	1.39	2.55	0.66	4.55	4.78	2.34	7.04	2.20	3.16	0.98	0.33	31.07
1980	0.94	0.67	1.12	0.83	2.29	5.52	2.30	3.26	3.68	0.66	0.26	0.24	21.77
1981	0.30	2.14	0.71	2.17	2.18	4.42	4.09	4.73	1.46	2.69	2.16	0.92	27.97
1982	2.45	0.63	2.09	1.62	4.99	1.44	0.92	3.80	1.50	3.45	3.27	4.27	30.43
1983	0.67	1.19	3.22	3.97	6.20	5.22	3.07	3.12	3.34	2.61	4.93	1.53	39.07
1984	0.88	1.64	1.47	3.86	2.29	7.95	3.03	5.15	2.65	5.48	0.31	2.24	36.95
1985	0.87	0.50	4.48	1.81	3.65	2.18	2.20	5.02	4.37	3.66	1.72	1.20	31.66
1986	0.90	0.84	2.03	5.88	3.48	5.34	4.11	4.44	6.90	1.77	0.62	0.31	36.62
1987	0.63	0.13	0.64	0.16	1.88	1.95	17.90	3.67	1.28	0.60	2.07	1.25	32.16
1988	1.37	0.30	1.33	1.58	1.70	0.22	1.17	4.29	2.79	0.80	2.86	0.67	19.08
1989	0.52	1.04	2.19	2.66	3.38	3.50	3.50	2.92	1.28	0.53	1.38	0.42	23.32
1990	0.10	0.77	3.66	3.80	3.36	9.82	5.06	1.71	1.88	1.23	0.65	1.01	33.05
1991	0.49	1.03	2.29	3.58	6.35	2.57	2.95	3.14	5.43	2.52	5.29	1.05	36.69
1992	0.66	0.57	1.56	1.99	1.15	3.68	5.21	4.54	5.20	2.11	1.95	1.05	29.67
1993	1.25	0.39	1.25	1.99	4.02	6.28	5.58	6.50	2.04	0.79	1.57	0.55	32.21
1994	1.17	0.78	0.32	3.77	2.21	3.09	4.12	2.90	4.74	4.65	1.39	0.53	29.67
1995	0.36	0.25	2.11	1.90	2.43	3.38	2.72	4.59	2.21	3.68	0.88	1.15	25.66
1996	1.87	0.24	1.39	0.76	2.37	4.76	2.09	1.43	1.30	3.01	5.08	1.75	26.05
1997	1.71	0.30	1.18	1.01	1.70	3.70	12.60	6.01	3.19	2.03	0.69	0.31	34.43
1998	1.64	0.80	4.56	1.56	4.40	6.52	2.63	5.99	1.32	2.19	1.32	0.46	33.39
1999	2.67	0.40	1.86	3.43	6.56	3.68	4.55	2.64	2.73	0.92	0.77	0.33	30.54
2000	0.90	1.08	1.12	1.12	4.56	4.56	6.10	3.19	2.15	1.09	3.38	1.23	30.48
2001	1.21	1.33	1.09	7.00	4.53	6.35	2.12	2.31	3.50	1.28	2.77	0.74	34.23
2002	0.46	0.36	1.38	3.23	2.83	8.30	5.19	8.30	3.89	4.21	0.09	0.21	38.45
2003	0.22	0.54	1.44	2.40	6.14	4.66	2.06	1.12	2.20	0.62	0.71	0.62	22.69
2004	0.23	1.09	2.11	2.06	6.39	3.06	3.36	1.19	4.21	2.32	0.93	0.44	27.39
2005	1.21	0.96	1.37	2.30	2.78	4.24	2.94	5.22	4.44	5.45	1.53	0.97	33.41
2006	0.71	0.32	2.01	5.97	1.66	2.81	1.29	6.90	2.44	0.41	0.92	2.13	27.57
2007	0.31	1.37	3.64	1.11	1.99	2.05	3.29	9.32	6.04	3.63	0.09	1.48	34.32
Avg (117 Years)	0.85	0.83	1.62	2.23	3.40	4.18	3.51	3.51	2.91	2.06	1.45	0.93	27.58

Minnesota Climatology Working Group

Minneapolis/St. Paul Metro Area Climate Page

Regularly Updated Twin Cities Climate Data

- Daily Climate Observations for Minneapolis/St. Paul
- Daily Climate Observations for Chanhassen (Snowfall for the 2000-2001 to 2003-2004 Winter)
- How to Read the Monthly Summary Form

- **Twin Cities Climate Calendar**

January	February	March	April
May	June	July	August
September	October	November	December

All-Time Twin Cities Climate Extremes

- Extreme Temperatures and Stretches of Extreme Temperatures for Minneapolis/St. Paul
- Extreme Precipitation/Snowfall Records for Minneapolis/St. Paul
- Monthly Mean Temperature/Total Precipitation Records

January	February	March	April
May	June	July	August
September	October	November	December

- Extremes of Snowfall for Minneapolis/St. Paul
- Snowfall Extremes by Month for Minneapolis/St. Paul
- Earliest and Latest First Snowfall and Snow Cover for Minneapolis/St. Paul
- Record cold windchill information for Minneapolis/St. Paul

Twin Cities Climate Data Summaries

- Normals, Means, and Extremes for Minneapolis/St. Paul (1971-2000)
- Minneapolis/St. Paul Snow Data Resources
- Snowfall Statistics for Minneapolis/St. Paul
- Median Frost Dates and Other Critical Critical Low Temperature Thresholds
- Average Date of Initial Soil Freeze
- Normal Precipitation (1971-2000) for New Hope

Historical Climate Data Listings for the Twin Cities

- Daily Maximum/Minimum Temps, Precip, Snowfall, Snow Depth
  - 1890 - 1899
  - 1900 - 1909
  - 1910 - 1919
  - 1920 - 1929
  - 1930 - 1939
  - 1940 - 1949
  - 1950 - 1959

- 1960 - 1969
- 1970 - 1979
- 1980 - 1989
- 1990 - 1999
- 2000 - 2008

- Minneapolis/St. Paul Monthly Snowfall Time-Series (1884 - 2008)
- Minneapolis/St. Paul Monthly Precipitation Time-Series (1891 - 2007)
- Minneapolis/St. Paul Monthly Average Temperature Time-Series (1891 - 2007)
- Minneapolis/St. Paul Monthly Heating Degree Day Time-Series(1891 - 2008)
- Minneapolis/St. Paul Monthly Cooling Degree Day Time-Series (1891 - 2007)
- 104 years of Twin Cities Dew Point Temperature Records (1902-2006)

Pioneer-Era Data

- Fort Snelling Data ...1820-1892
- Yearly Graphical Portrayal of Daily Max/Min Temperatures for the MSP area, 1820-2008
- Year-by-Year Narrative Account of Pioneer Weather (1820-1869)

(last two courtesy meteorologist Charles Fisk - Newbury Park, California)

Last modified: August 14, 2008

Twin Cities Monthly and Yearly Mean Daily Temperature (F)
1891 - 2006

Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Downtown Minneapolis													
1891	24.4	13.5	25.1	49.6	58.7	66.2	66.5	68.2	67.7	50.1	28.6	30.1	45.7
1892	13.6	22.4	29.9	43.5	51.7	64.7	71.6	70.0	63.5	53.5	29.5	17.0	44.3
1893	7.3	12.1	25.0	40.3	54.5	72.0	74.1	69.5	63.0	50.5	32.8	14.0	42.9
1894	12.3	15.7	36.5	49.6	59.0	73.3	77.0	72.4	64.3	50.1	28.5	28.5	47.3
1895	6.3	12.1	30.0	53.1	59.6	67.9	70.7	70.2	66.2	45.0	32.0	22.6	44.7
1896	16.8	22.4	26.3	48.3	64.1	69.1	71.9	71.2	57.9	46.4	22.6	24.4	45.1
1897	10.7	20.1	24.7	46.5	57.4	65.0	74.5	66.9	68.8	54.5	29.6	15.3	44.5
1898	23.0	20.6	34.7	45.4	58.2	68.7	73.3	69.6	64.2	45.9	29.7	14.1	45.6
1899	13.2	7.9	17.1	48.2	58.3	67.7	73.4	72.2	59.4	52.8	41.2	21.4	44.4
1900	21.3	8.6	25.6	52.8	62.0	68.8	71.0	76.7	61.5	57.8	28.6	21.0	46.3
1901	15.2	12.3	29.0	49.5	59.3	69.1	77.4	72.3	60.0	51.7	31.0	15.9	45.2
1902	18.7	18.2	36.2	44.6	60.2	64.1	71.6	66.5	57.3	49.6	36.1	15.6	44.9
1903	14.6	14.8	33.6	45.1	59.1	65.5	69.4	65.1	58.3	50.0	29.8	12.6	43.2
1904	7.3	5.2	27.7	41.0	57.6	65.7	68.4	66.3	59.7	48.8	38.6	19.9	42.2
1905	7.4	11.9	35.1	44.0	54.2	64.9	69.8	70.8	63.7	45.6	35.3	23.9	43.9
1906	20.0	16.3	22.5	50.4	55.6	66.5	70.8	71.3	65.5	47.9	33.6	19.8	45.0
1907	7.2	17.5	31.4	37.1	46.9	65.6	71.2	69.1	58.5	47.9	34.6	25.0	42.7
1908	19.9	21.5	29.3	46.7	56.3	65.1	72.7	69.0	68.0	49.1	36.3	21.1	46.3
1909	14.5	18.0	29.2	38.5	55.6	67.4	71.6	73.9	61.0	46.9	37.6	12.8	43.9
1910	15.4	11.5	45.0	50.6	54.8	71.2	73.9	69.1	61.5	54.0	27.9	19.1	46.2
1911	11.2	22.0	36.0	45.8	63.6	73.1	71.1	66.7	59.3	45.9	23.0	24.1	45.2
1912	-2.7	13.6	24.2	48.7	59.0	65.2	71.3	66.8	61.2	51.4	37.5	24.0	43.4
1913	13.1	12.7	25.7	49.0	55.7	70.5	70.5	72.9	61.4	46.4	40.2	30.5	45.7
1914	21.5	7.2	30.6	44.7	60.5	66.8	75.1	69.2	62.4	55.4	36.0	12.2	45.1
1915	12.6	25.5	27.9	56.0	52.2	62.5	67.2	65.5	60.7	51.4	35.5	22.7	45.0
1916	10.1	11.1	26.0	43.6	56.9	62.9	79.1	72.1	59.8	46.9	34.6	12.4	43.0
1917	7.1	5.7	27.2	41.9	54.6	63.3	73.0	67.5	60.0	38.6	38.8	9.9	40.6
1918	4.1	18.0	39.1	44.3	60.1	66.8	70.7	70.9	55.1	50.9	37.8	28.5	45.5
1919	22.3	16.4	30.9	45.2	58.2	70.2	74.6	69.4	64.3	44.7	26.7	10.9	44.5
1920	7.7	16.0	31.3	38.6	59.3	68.4	70.6	70.0	65.5	56.5	33.1	23.6	45.1
1921	22.1	24.2	33.6	50.6	60.1	74.4	77.5	70.4	64.0	51.4	27.5	20.5	48.0
1922	13.8	11.6	32.4	45.8	63.3	69.4	70.0	73.5	65.7	53.6	39.6	18.2	46.4
1923	18.0	10.3	21.5	44.0	59.7	71.2	76.0	67.3	63.1	48.0	39.5	29.9	45.7
1924	8.0	21.7	29.9	44.3	50.4	64.6	69.9	68.1	57.6	56.6	33.1	9.3	42.8
1925	14.3	21.6	35.2	53.2	55.4	67.2	70.8	72.4	65.8	38.3	32.6	16.7	45.3
1926	17.0	23.7	26.1	44.3	62.5	64.1	72.7	69.8	57.5	47.2	27.5	15.0	44.0
1927	13.7	23.1	35.5	46.4	53.8	64.9	69.5	67.0	63.1	51.8	30.0	8.8	44.0
1928	17.2	21.7	32.9	39.6	61.1	62.6	72.3	70.4	58.3	50.7	36.4	25.7	45.8
1929	2.0	10.5	34.2	46.8	54.9	65.7	74.1	70.9	59.0	49.9	29.0	18.1	42.9
1930	7.0	27.4	31.7	49.4	58.4	68.6	75.3	75.3	62.4	47.9	37.1	23.1	47.0
1931	25.9	32.0	31.4	50.1	56.1	73.7	76.9	70.6	68.7	54.4	40.3	30.0	50.9
1932	18.1	19.4	21.9	46.7	59.1	72.3	74.7	72.7	62.0	46.4	30.7	16.8	45.1
1933	23.1	14.3	30.5	44.9	58.8	78.0	77.1	70.8	67.4	47.4	30.7	17.0	46.7
1934	21.2	18.6	29.0	46.0	68.7	73.1	76.2	70.1	57.3	54.0	38.8	15.0	47.3
1935	11.0	25.5	34.1	44.1	54.9	64.3	79.9	72.6	62.2	48.6	28.6	17.6	45.3
1936	3.9	-0.0	29.9	39.8	64.2	66.4	81.4	74.7	66.7	46.4	30.1	22.6	43.9
1937	5.5	13.5	27.0	44.5	59.8	67.2	77.1	77.7	63.5	46.7	31.9	17.9	44.4
1938	13.5	21.8	38.1										
At 1pm on April 9th, 1938 the official observation was transferred to The Twin Cities International Airport.													
				46.0	56.8	67.9	73.5	73.8	62.3	55.4	31.5	20.4	46.8
1939	19.7	9.2	29.4	42.4	63.9	68.6	74.6	71.3	64.2	47.5	37.7	27.7	46.4
1940	6.5	19.4	24.2	43.7	56.0	68.1	75.8	68.8	65.3	54.0	27.8	22.0	44.3
1941	17.4	14.8	28.1	52.9	63.3	69.1	74.7	72.6	63.2	50.9	36.5	26.3	47.5
1942	20.5	20.8	35.8	52.2	56.0	66.8	71.5	70.5	57.3	50.3	33.6	15.5	45.9
1943	7.9	17.4	23.6	44.4	55.7	70.4	74.6	71.9	58.2	49.5	29.5	23.4	43.9
1944	26.5	20.6	25.9	43.0	62.5	69.7	71.4	71.7	61.7	51.2	37.8	19.3	46.8
1945	12.7	17.7	39.8	43.9	52.1	61.4	70.4	71.0	60.2	48.6	31.8	13.4	43.6
1946	15.2	16.8	42.4	51.1	55.2	67.1	73.6	68.8	59.8	51.3	33.1	20.6	46.3
1947	21.6	14.8	28.9	42.1	53.5	64.6	72.8	78.2	63.1	59.3	26.6	17.7	45.3
1948	10.1	15.6	27.3	50.0	58.5	67.3	75.2	72.7	67.6	51.2	35.1	20.0	45.9

1949	14.1	13.4	29.5	47.1	62.0	72.2	76.4	74.3	58.5	52.9	37.2	20.4	46.5
1950	6.8	16.4	24.0	36.9	56.1	67.8	70.5	67.7	62.6	53.7	27.8	12.4	41.9
1951	9.3	17.5	21.1	42.3	62.0	64.7	71.8	68.1	56.9	49.0	25.6	16.4	42.1
1952	12.5	23.7	26.1	50.1	58.7	69.6	73.2	69.1	63.1	44.4	35.3	23.4	45.8
1953	16.7	17.9	30.6	40.9	58.5	70.9	72.5	73.3	62.1	57.4	39.3	22.0	46.9
1954	10.3	31.8	27.9	46.5	53.1	71.2	74.4	70.4	60.5	47.7	38.3	23.4	46.3
1955	14.1	14.4	25.7	53.9	63.3	68.2	78.0	76.1	63.0	51.4	25.6	12.2	45.5
1956	12.7	15.0	25.9	41.8	57.8	73.4	69.9	71.2	58.7	56.5	34.1	23.9	45.1
1957	9.9	20.6	30.4	46.9	57.0	67.3	76.5	70.7	59.4	48.7	32.7	25.3	45.5
1958	22.4	15.5	33.3	47.9	60.8	63.3	70.3	71.4	62.7	53.1	35.7	15.9	46.0
1959	10.6	17.2	34.0	47.1	60.6	70.8	74.5	75.2	63.1	44.4	25.4	30.1	46.1
1960	17.5	17.8	19.8	45.9	57.0	63.8	71.7	72.1	61.8	48.7	33.3	16.8	43.9
1961	12.0	22.5	32.0	38.5	54.7	68.1	71.0	71.3	59.1	52.2	33.5	15.3	44.2
1962	7.1	11.7	24.5	42.2	60.6	66.2	67.5	68.3	56.4	50.2	35.0	19.0	42.4
1963	2.9	12.1	34.2	47.4	55.4	69.8	73.5	68.9	62.2	58.1	38.3	10.0	44.4
1964	20.0	23.9	25.8	46.8	61.5	68.7	76.0	68.5	58.9	48.2	35.0	14.8	45.7
1965	10.0	11.8	19.5	41.8	58.7	66.5	70.5	68.6	52.8	50.7	33.1	28.0	42.7
1966	3.3	16.3	35.8	42.2	53.6	68.4	76.8	68.2	60.3	47.5	30.1	18.1	43.4
1967	14.6	8.7	29.8	44.7	52.3	66.9	68.8	66.2	60.3	46.3	30.7	21.8	42.6
1968	14.3	15.2	38.8	48.5	53.4	67.2	71.1	70.7	61.1	50.7	34.0	16.9	45.2
1969	9.4	19.3	24.1	49.3	60.6	61.8	73.6	74.4	63.0	46.5	33.6	20.3	44.7
1970	5.6	15.4	26.0	46.1	58.5	71.2	75.2	71.9	61.2	49.6	32.7	18.2	44.3
1971	6.5	17.0	28.0	47.0	55.4	71.5	68.8	69.6	62.8	51.4	32.7	18.4	44.1
1972	5.5	10.5	26.5	41.9	61.3	66.0	68.5	69.8	57.9	43.7	32.2	11.3	41.3
1973	17.4	21.6	40.2	44.4	55.2	69.5	73.8	73.4	60.1	53.8	34.3	16.7	46.7
1974	11.9	16.9	29.5	47.1	54.4	65.5	76.6	67.3	55.3	49.8	33.7	24.4	44.4
1975	14.5	15.5	22.1	38.9	60.9	68.8	76.3	71.7	57.7	52.8	37.5	21.3	44.8
1976	11.6	27.8	31.4	51.8	58.9	71.7	76.1	73.3	61.8	44.6	28.3	13.6	45.9
1977	0.3	22.7	37.5	53.0	66.9	68.4	74.8	66.1	60.5	47.1	30.8	14.4	45.2
1978	5.5	11.6	30.0	45.2	61.8	67.8	71.1	72.2	67.3	49.8	32.5	15.2	44.2
1979	3.2	10.0	28.9	44.0	55.5	67.3	73.6	69.9	63.4	46.6	31.7	26.0	43.4
1980	15.3	15.3	27.3	49.2	61.5	67.6	75.2	70.7	59.5	45.1	36.6	19.8	45.3
1981	18.0	23.4	37.7	49.1	57.1	67.0	70.9	69.3	60.0	46.7	38.0	17.5	46.2
1982	2.3	15.8	29.0	43.8	62.5	63.7	75.6	71.8	60.9	50.3	31.5	25.7	44.4
1983	19.6	26.9	34.2	42.3	54.6	68.0	77.2	76.8	62.6	48.4	34.0	3.7	45.7
1984	12.0	27.5	24.8	47.1	56.0	69.7	72.2	73.5	57.2	50.7	33.3	17.9	45.2
1985	10.1	16.5	35.6	52.1	62.2	63.9	73.9	67.6	59.9	47.5	24.8	7.7	43.5
1986	17.5	15.7	33.9	49.6	59.4	68.6	73.9	67.1	59.8	49.2	28.2	24.7	45.6
1987	21.2	31.6	38.7	53.5	63.5	72.8	76.0	69.0	62.5	44.6	37.9	25.0	49.7
1988	10.4	13.9	33.8	47.4	65.4	74.4	78.1	73.9	62.4	44.0	32.7	20.5	46.4
1989	21.2	8.6	26.6	45.3	57.5	68.4	76.4	70.8	60.9	49.9	28.0	10.6	43.7
1990	26.3	23.7	35.7	46.8	56.3	69.5	71.3	70.6	64.4	48.1	37.4	16.9	47.3
1991	12.5	24.4	34.3	49.1	61.9	72.9	72.3	71.1	59.0	47.2	24.5	21.2	45.9
1992	21.9	28.0	33.1	43.6	60.5	65.6	65.8	65.9	59.6	47.4	31.4	21.2	45.3
1993	14.6	17.2	29.5	44.2	57.2	64.5	70.3	70.4	55.0	46.5	30.6	22.2	43.5
1994	4.4	13.2	34.7	45.9	60.7	69.9	70.1	67.4	64.3	52.2	38.0	24.5	45.5
1995	18.5	19.3	35.0	42.2	56.9	71.2	73.1	74.7	60.2	48.6	27.4	19.1	45.5
1996	10.2	18.0	25.3	41.4	55.6	67.4	70.0	70.5	62.2	48.8	27.4	13.7	42.6
1997	10.3	19.9	29.3	43.0	53.4	70.0	71.0	68.8	62.4	50.2	28.1	26.9	44.5
1998	19.1	31.9	31.9	50.7	63.4	64.9	72.6	71.6	66.6	51.2	37.2	24.6	48.8
1999	12.4	27.9	33.8	49.3	60.1	67.3	76.2	70.1	61.1	49.6	41.8	25.6	47.9
2000	15.9	27.9	41.1	46.7	60.9	66.1	72.4	72.2	61.6	53.3	31.2	7.6	46.4
2001	20.0	11.8	27.5	48.4	59.7	69.1	75.9	74.2	60.9	48.6	46.4	27.6	47.5
2002	24.6	28.3	24.9	45.7	54.6	71.1	77.0	70.9	65.5	41.8	33.0	26.2	47.0
2003	15.3	15.7	31.3	48.3	57.7	68.2	73.7	75.3	62.5	51.0	32.1	25.0	46.4
2004	11.2	21.6	36.0	49.9	56.6	65.4	72.2	66.3	67.4	50.1	37.7	22.6	46.4
2005	15.6	26.4	31.8	52.0	56.4	73.4	76.8	71.7	66.3	52.3	36.6	19.4	48.2
2006	28.6	20.0	33.6	53.5	61.9	70.9	79.6	72.1	59.6	45.9	36.8	29.1	49.3
2007	19.7	13.5	38.4	47.2	64.2	72.7	76.0	71.1	64.8	54.3	34.5	16.6	47.8
Avg (117 Years)	13.6	17.7	30.4	46.2	58.3	68.1	73.3	70.7	61.6	49.6	33.1	19.6	45.2

Field Office Guide to Climatic Data

Table of Contents

Introduction [TOC]

The Natural Resources Conservation Service is charged with management of not only soil, but all five SWAPA resources (soil, water, air, plants, animals), and human considerations. SWAPA management requires an understanding of the resources, as well as interactions between resources. Many concerns about the resources can be addressed through climate information and specific climatic data.

Climate is an important factor driving the agriculture of a given region (along with soils, water available for irrigation, societal influences, economics, others). Under many situations, climate is THE determining factor which defines which crops can be grown in an area. For instance, although the soils and economics of North Dakota may support growing cotton, the climate there (specifically temperature and precipitation) would not allow cotton to grow and mature.

This publication concerning climatic data is oriented to the NRCS role in American agriculture and natural resource conservation. It describes the NRCS National Water & Climate Center (NWCC) and its network of liaisons in each NRCS state office.

How to Use this Guide [TOC]

This guide is divided into 7 sections. Section 1 contains detailed information about climatic data elements, measurement methods, and problems associated with collecting climatic data. Sections 2, 3, and 4 provide material to help understand data collection systems. Section 5, Climate Terminology, contains definitions of climatic terms. Section 6 explains how climatic information can be obtained. Climatic data needs associated with a particular conservation practice are listed in Section 7.

1 Climatic Data Element Descriptions, Measurement Methods, and Errors Associated with it's Collection. *[TOC]*

The following description of climatic data elements is a condensation of the material contained in the National Weather Service Observing Handbook No.2, Cooperative Station Observations, the Weather Station Handbook an Interagency Guide for Wildland Managers, and the American Meteorological Society Glossary of Meteorology.

Statistical analysis of climatic data generates descriptive information which reflects the average atmospheric conditions at a location, as well as generating probabilities that extreme events will occur. Any statistical analysis of climatic data, due mainly to the limited number of samples available, must follow the rules for statistical analysis. An important rule governing small sample analysis requires a minimum of 30 samples. This does not mean that climatic data with less than 30 years of data can not be analyzed, but that some adjustment be made to estimate what a 30 sample set would produce.

AIR TEMPERATURE *- Temperature is a measure of the hotness or coldness of air. It is measured on some definitive temperature scale. Two scales are commonly used. The Fahrenheit and Centigrade temperature*

scales establish the freezing of water at 32/0 degrees respectively and boiling point at 212/100 degrees respectively. The Fahrenheit scale is used most frequently in the US and Centigrade throughout the rest of the world. Air temperature is usually measured with either a liquid-in-glass maximum and minimum thermometer mounted in a vented, wooden box or with an electronic sensor. .

It is important that thermometers be shaded from sunlight to avoid an erroneously high measured temperature. Instrument shelters are designed to rectify this problem. For more information on instrument shelters, see the Weather Station Handbook - an Interagency Guide for Wildland Managers.

***EVAPORATION** - Evaporation is the physical process by which a liquid is transformed to a gaseous state. Evaporation is influenced by solar radiation, air temperature, vapor pressure, wind, and possibly atmospheric pressure. Evaporation varies with latitude, altitude, season, time of day, and sky condition. Accurate evaporation readings requires careful maintenance of an evaporation pan which contains water. The water depth is measured daily and adjusted for any precipitation which may occur.*

***PRECIPITATION** - Precipitation refers to all forms of water, liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes, but is not limited to, rain, drizzle, snow, hail, graupel, sleet, and ice crystals. It is one of the most basic data elements collected by any climate station. Dew, frost and rime are excluded, since they are a result of water vapor in air condensing or freezing onto a surface.*

The standard U.S. precipitation gage has an eight inch diameter mouth and height of about 30 inches. Non-recording gages simply collect precipitation; amount of precipitation must be measured by an observer. Recording gages have instrumentation which records the time, duration, and intensity of precipitation. Most recording gages store information on a paper strip, which is generally changed weekly by an observer. Precipitation intensity and duration, useful information for many NRCS design activities, can be derived from information gathered by precipitation gages.

The biggest factor in precipitation measurement error is wind. Strong winds during precipitation events can cause considerable differences between measured and actual precipitation. Measurement errors can also result from small amounts of dew, frost, and rime accidentally included in the total measured precipitation. Even with careful placement, all gages underestimate the real precipitation, particularly with snowfall.

***NEW SNOW** - New snow is the incremental amount of snow that has fallen since the last snow depth observation. Delineating between new snow and old snow presents a challenge. A snow board (generally a sheet of plywood) can provide an artificial surface at the top of the existing snow. Snow boards are laid on top of old snow when there is any possibility of new snow falling. After each observation of new snow, the board is cleaned and placed in a new location. Board placement and measurement location are the greatest source of error in determining new snow.*

***SNOW DEPTH** - Snow depth is the actual depth of snow on the ground at the time of measurement. Snow depth is usually measured daily and determined to the nearest whole inch with a calibrated stick, such as that used with the 8-inch non-recording rain gage, or a ruler or yardstick. Snow should be measured in several locations and averaged to avoid errors induced by drifted snow.*

***SNOW WATER EQUIVALENT** - The water equivalent of snow is the depth of water that would be obtained by melting the snow cover. Water equivalent of snow is continuously measured (weighed) by recording gages which are winterized with an antifreeze solution. For non-recording gages, the snow catch collected by the standard rain gage (with the funnel and small tube removed) is melted by adding a known amount of warm water. The total amount is then measured and the added amount of warm water subtracted to yield the observed water equivalent. Most snow water equivalent measurement errors are associated with not selecting a representative location or the mechanics of subtracting water added to the total catch.*

***SOIL TEMPERATURE** - Soil temperature measures the hotness or coldness of soil. Soil temperature is very important to the agricultural industry. Most seeds require a certain soil temperature in order to germinate. Soil temperatures are commonly measured at 2, 4, 8, 20, 40, 60, and 120 inches with the 4 inch reading being the most frequently observed. Readings are usually observed and recorded daily. Maximum, minimum, and current temperatures are generally recorded above 8 inches. At greater depths, where temperature changes more slowly, only the current temperature is normally recorded. Different species of plants have specific soil temperature ranges in which they will grow.*

***SOLAR RADIATION - INCOMING** - Incoming solar radiation is the total electromagnetic radiation emitted by the sun striking the earth. Much solar radiation is absorbed by air molecules, reflected back into space, or refracted as it passes through the atmosphere. A pyrheliometer measures the direct solar radiation that passes through the atmosphere unimpeded. It consists of an enclosed radiation sensing element with a small aperture through which the direct solar rays enter. A pyranometer measures the combined incoming direct solar*

radiation and diffuse sky radiation. It is mounted such that it views the entire sky. Both instruments can be connected to electronic recording devices to collect the measurements. Solar radiation sensors must be cleaned regularly and exposed properly to accurately measure solar radiation.

***WIND** - Wind is the motion of air relative to the surface of the earth. Wind speed and direction, the two primary elements, are usually measured with an anemometer and wind vane, respectively. Wind speed is generally measured in miles per hour; direction is measured in degrees to the nearest ten(s) (10 to 360) with 360 degrees being north, 90 degrees being east, 180 degrees representing south, and 270 degrees being west. Wind measurement accuracy is primarily influenced by sensor height and nearby objects.*

***2 Climate Station Metadata** [TOC]*

Climate Stations are locations at which climatic data are gathered. Biographical and index information describing the climatic station, called "Metadata", are used in conservation applications and resource evaluations.

***STATION ID** - Identification number for the climate station assigned by the agency responsible for the particular station.*

***STATION NAME** - The full name of the climate station as recognized by the agency responsible for the climate station.*

***STATION LATITUDE** - Latitude defines a site's location based on its relative distance from the equator going toward the North or South poles. Station latitude is measured in degrees, minutes, and seconds, with 0 degrees being on the equator, and 90 degrees north or south being the North and South Poles, respectively. The latitude of a particular climate station is determined by the agency managing the station and is generally recorded to the nearest minute.*

***STATION LONGITUDE** - Longitude defines a sites relative distance, up to 180 degrees, west or east of a North-South line running through Greenwich, England. The longitude of a particular station is determined by the agency managing the station. Measurement is generally made to the nearest minute.*

***STATION ELEVATION** - The elevation of a climate station is usually measured in feet above mean sea level.*

***3 Climatic Element** [TOC]*

A climatic element is a measured parameter which helps to specify the climate of a specific location or region, such as precipitation, temperature, wind speed and humidity. Descriptive terminology for climatic elements are:

***ELEMENT NAME** - The full description of the element being referenced at the climate station (i.e. maximum temperature).*

***ELEMENT ID** - Is a shortened identifier for the element, usually 4 characters in length (i.e. TMAX(maximum daily temperature), TMIN(minimum daily temperature), PRCP(precipitation, etc).*

***ELEMENT DURATION** - The interval between measurements of a data element. Common data element durations available for the station could include monthly, daily, or hourly.*

***4 Climate Data Measurement Networks** [TOC]*

National Weather Service Cooperative Station Network

Cooperative stations generally record daily precipitation and/or maximum and minimum temperature. Several other weather parameters may also be observed, such as evaporation, wind movement, and soil temperature.

The following table lists specific climate elements and the number of National Weather Service stations which measure it:

DATA ELEMENT	NUMBER OF MEASURING STATIONS
Precipitation	10,700
Snow Depth	10,700
New Snow	10,700
Temperature	7,000
Wind	500

Evaporation	300
Incoming Solar Radiation	250
Soil Temperature	300

Natural Resources Conservation Service (NRCS)

The NRCS operates an automated network of approximately 600 stations in the western U.S. called SNOTEL (SNOwpack TELemetry). Begining October 1st these stations report accumulated seasonal precipitation , snow water equivalent, and temperature (maximum, minimum, current and average) daily. This network was established in the late 1970s to support water supply forecasting. It uses meteorburst technology to transmit data from remote sites to data gathering locations. SNOTEL augmented and partially replaced the cooperative network of manual snow courses that NRCS acquired and established the mid 1930s.

5 Climate Glossary [TOC]

The following lists terms which provide descriptive information for climatic datasets:

ALBEDO *- The ratio of the amount of radiation reflected by a body to the amount of radiation incident upon it; expressed as a percentage.*

CLIMATE *- the synthesis of weather, or averaging of weather conditions over a given time period.*

DEGREE DAYS, COOLING *- A value used to estimate the energy requirements for air conditioning of homes and buildings. One cooling degree day is given for each degree the daily mean temperature is above 75 degrees Fahrenheit.*

DEGREE DAYS, GROWING *- Growing degree days (GDD) measures the day to day accumulation of the difference between the average daily temperature and a threshold temperature for a specific crop. GDD's give an indication of the amount of heat available for crop growth.*

DEGREE DAYS, HEATING *- A value used to estimate the energy requirements for heating homes and buildings. One heating degree day is given for each degree the daily mean temperature is below 65 degrees Fahrenheit.*

DEWPOINT *- The temperature to which air is cooled for water vapor to begin condensing.*

DRIZZLE *- Very small, numerous, and uniformly dispersed water drops that may appear to float while following air currents. Unlike fog droplets, drizzle falls to the ground.*

DURATION *- the period or time increment to which an observed or computed value applies.*

EVAPORATION *- Evaporation is the physical process by which a liquid is transformed to a gaseous state.*

EVAPOTRANSPIRATION (ET) *- The combined processes of evaporation and transpiration.*

FOG *- A visible collection of minute water droplets suspended in the atmosphere near the earth's surface. Fog reduces visibility below one kilometer (0.62 miles).*

FREEZE *- A freeze occurs at any time the surface air temperature reaches 28 degrees or less. This temperature causes damage to most vegetation except certain species which are resistant to freezing.*

FREEZE FREE PERIOD *- Freeze free period is the number of consecutive days where the air temperature does not fall below 28 degrees Fahrenheit.*

FREEZE, KILLING *- A killing freeze occurs at or below 24 degrees Fahrenheit and causes permanent damage to almost all vegetation.*

FREEZE FREE PERIOD, KILLING *- Killing freeze free period is the number of consecutive days where the air temperature does not fall below 24 degrees Fahrenheit.*

FROST *- Frost is the process of deposition of frozen atmospheric water vapor on surfaces whose surface air temperature is below 32 degrees Fahrenheit. A frost can occur at any time the surface air temperature falls to 32 degrees Fahrenheit or less. This temperature may cause damage to very young vegetation or vegetation that has no resistance to frost. Most fruit falls in this category.*

FROST FREE PERIOD *- Frost free period is the number of consecutive days where the surface air temperature does not fall below 32 degrees Fahrenheit.*

FROST, FIRST *- First Frost is the first date following the growing season that the minimum temperature drops below an index temperature, usually 32 degrees Fahrenheit. The first frost usually occurs in the fall of the year, but it may occur during the winter months, or in some locations may not occur at all.*

FROST, LAST *- Last Frost is the last date preceding the growing season that the minimum temperature drops below an index temperature, usually 32 degrees Fahrenheit. The last frost usually occurs in the spring of the year but may occur very early in the summer or not at all in some locations. First and Last frosts are analyzed at three temperatures (32, 28, and 24 degrees Fahrenheit) specifically relating to damage caused to vegetation by the sub-freezing temperatures.*

GROWING SEASON *- Growing Season is the number of consecutive days where the temperature has not gone below an index temperature for specific vegetation. If vegetation is more resistant to cold temperatures the index temperature would be lower. The index temperatures used in growing season analysis usually include 24, 28, and 32 degrees Fahrenheit.*

GROWING SEASON PERIOD *- Growing Season Period is the period of time, beginning date and ending date, that defines the period that the temperature has not dropped below the index temperature.*

HAIL *- Precipitation in the form of balls or irregular lumps of ice with a diameter of 5 mm or more, always produced by convective clouds, nearly always cumulonimbus.*

HUMIDITY, RELATIVE *- A measure of the amount of water in the air compared to the amount of water vapor the air has the potential to hold. (Note: the potential of air to hold water changes with air temperature. Therefore, relative humidity can change as air temperature changes without an actual change in the amount of water vapor.)*

INDEX TEMPERATURE *- A temperature which denotes the beginning of a specific event such as 28 degrees Fahrenheit. The 28 degree temperature denotes a freeze that can damage plants.*

NORMAL *- "Normal" is an average of any of the climatic elements calculated for a specific time period. The beginning and ending years of the normal period are established by the World Meteorological Organization. This organization has defined the current standard averaging period for "Normals" as 1971 through 2000. Normals have been established as the standard period that will be used in analysis of climatic data to allow for comparable descriptive information representative of average conditions over the time period.*

PERIOD OF RECORD *- The time interval during which meteorological and climatic data have been gathered at a climatic station.*

PRECIPITATION *- Precipitation refers to all forms of water, liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes, but is not limited to, rain, drizzle, snow, hail, grapple, sleet, and ice crystals.*

PROBABILITY *- Probability is a statistical process that provides for the analysis of data to determine the potential of an individual value to occur at a specified time, in a given year, or in a given period of time. An example might indicate that a certain value has a 10 percent chance of occurrence in any year, or that the value has a chance of returning once in a period of ten years.*

RAIN *- Precipitation in the form of liquid water drops which have diameters greater than 0.02 in (0.5 mm).*

WIND ROSES *- A type of analysis that describes wind measurements graphically and tabularly as a combination of the cardinal direction that the wind was coming from and the average speed from that direction for a particular time interval.*

SLEET *- A type of precipitation consisting of transparent or translucent pellets of ice 5 mm or less in diameter. Sleet forms when raindrops fall through a layer of below-freezing air near the earth's surface.*

SNOW WATER EQUIVALENT *- The water equivalent of snow is the depth of water that would be obtained by melting the snow cover.*

SOLAR RADIATION *- The total amount of energy emitted by the sun.*

SOLAR RADIATION, INCOMING *- Incoming solar radiation is the total electromagnetic radiation emitted by the sun striking the earth.*

TEMPERATURE *- Temperature is a measure of the internal energy of molecular motion in a substance.*

THRESHOLD TEMPERATURE *- A temperature that denotes the boundary condition for a specific event. For example, a crop specific temperature below which the growth of that crop is minimal.*

TRANSPIRATION *- The process by which water in plants is transferred to the atmosphere as water vapor.*

WEATHER *- the instantaneous or short-term state of the atmosphere.*

WIND *- Wind is the motion of air relative to the surface of the earth.*

6 National Water & Climate Center/Climatic Data Access Network [TOC]

The Natural Resources Conservation Service's National Water & Climate Center was created to provide the climatic data analyses needed by NRCS employees and offices to perform conservation activities. Each state and national center has been assigned a Climatic Data Liaison (CDL) to deliver climatic data to field offices as well as other offices in the state requiring climatic data. These Climatic Data Liaisons make up what is known as the Climatic Data Access Network (CDAN). CDAN provides a corp of knowledgeable individuals to assist NRCS field offices in the analysis of climatic data.

The mission of NWCC/CDAN is to access, obtain, evaluate, manage, and disseminate the climatic data needed to support agency programs and activities nationally. The Vision of NWCC/CDAN is "A dynamic, agency-wide climate service network -- providing data and analyses required for integrated ecosystem management."

A wide variety of daily, monthly, and annual data are available through NWCC/CDAN, including air and soil temperature, evaporation, wind movement, snow depth, snow water equivalent and precipitation. Climatic interpretations (probabilities and statistical summaries) for temperature and precipitation, growing season and construction information, rainfall frequency, and information for agronomic and engineering models are available through the Network.

The following examples demonstrate the variety of information available through NWCC/CDAN:

TEMPERATURE AND PRECIPITATION SUMMARY (TAPS) [TOC]

The TAPS table gives a month by month summary and probability analysis of temperature and precipitation.

TAPS Station : DECORAH, 192110
Start yr. - 1971 End yr. - 2000
Temperature: 30 years available out of 30 requested in this analysis
Precipitation: 30 years available out of 30 requested in this analysis

	Temperature					Precipitation				
				2 yrs in 10 will have			2 yrs in 10 will have		avg no of days	avg
Month	avg daily max	avg daily min	avg	max temp. >than	min temp. <than	avg grow deg days*	avg (in.)	less than (in.)	more than (in.)	w/ 0.10 inch or more	snow-fall
January	23.7	5.3	14.5	49	-29	1	0.74	0.27	1.14	2	7.0
February	29.6	10.7	20.1	54	-22	3	0.82	0.32	1.29	2	7.2
March	42.0	23.6	32.8	73	-10	55	1.89	1.05	2.64	4	7.5
April	58.2	36.3	47.2	84	14	256	3.42	1.96	4.71	6	1.6
May	70.8	47.7	59.2	89	27	597	3.82	2.60	4.94	7	0.0
June	79.7	56.7	68.2	95	39	846	4.20	2.29	5.89	6	0.0
July	83.7	61.4	72.6	97	46	1010	3.99	2.28	5.51	6	0.0
August	81.5	59.0	70.3	95	42	937	4.03	2.04	5.76	6	0.0
September	72.7	50.7	61.7	91	29	651	3.93	1.53	5.95	6	0.0
October	61.0	39.9	50.5	84	18	339	2.27	1.07	3.31	4	0.2
November	43.8	27.0	35.4	67	1	65	1.68	0.65	2.64	4	3.4
December	28.3	12.1	20.2	56	-21	5	1.21	0.63	1.73	3	9.7
Yearly :											
Average	56.3	35.9	46.1	---	---	---	---	---	---	---	---
Extreme	101	-39	---	98	-31	---	---	---	---	---	---
Total	---	---	---	---	---	4764	32.01	26.89	36.67	56	36.5

A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold : 40.0 deg. F)

FROST FREE DAYS (FROST) [TOC]

The FROST table provides information on the average date of the last temperature below 24, 28, and 32 degrees Fahrenheit in the spring, and the average date of the first temperature below 24, 28, and 32 degrees Fahrenheit in the fall, at probabilities of 10, 20, and 50%.

FROST Station : DECORAH, 192110
Start yr. - 1971 End yr. - 2000
Requested years of data: 30 Available years of data: 30
Spring: Missing data years 24 deg = 0, 28 deg = 0, 32 deg = 0
Years with no occurrence 24 deg = 0, 28 deg = 0, 32 deg = 0
Data years used 24 deg = 30, 28 deg = 30, 32 deg = 30
Fall: Missing data years 24 deg = 1, 28 deg = 1, 32 deg = 1
Years with no occurrence 24 deg = 0, 28 deg = 0, 32 deg = 0
Data years used 24 deg = 29, 28 deg = 29, 32 deg = 29

	Temperature		
Probability	24F or lower	28F or lower	32F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 22	May 9	May 22
2 year in 10 later than--	April 17	May 3	May 16
5 year in 10 later than--	April 8	April 23	May 5
First freezing temperature in fall:			
1 yr in 10 earlier than--	October 8	September 26	September 23
2 yr in 10 earlier than--	October 13	October 1	September 26
5 yr in 10 earlier than--	October 23	October 12	October 4

GROWING SEASON (GROWTH) [TOC]

The GROWTH table gives average length of growing season using three index temperatures (32, 28, and 24 degrees Fahrenheit) at 10, 20, 50, 80, and 90% probabilities.

GROWTH Station : DECORAH, 192110
Start yr. - 1971 End yr. - 2000
Requested years of data: 30 Available years of data: 30
Missing data years 24 deg = 1, 28 deg = 1, 32 deg = 1
Years with no occurrence 24 deg = 0, 28 deg = 0, 32 deg = 0
Data years used 24 deg = 29, 28 deg = 29, 32 deg = 29

	Daily Minimum Temperature		
Probability	# days > 24F	# days > 28F	# days > 32F
9 years in 10	177	148	131
8 years in 10	184	156	138
5 years in 10	197	170	151
2 years in 10	210	185	163
1 year in 10	217	193	170

WETLANDS DETERMINATION (WETS) [TOC]

The WETS table gives a month by month summary and probability analysis of temperature and precipitation. The table also provides average length of growing season using three index temperatures (32, 28, and 24 degrees Fahrenheit) at 50 and 70% probabilities.

WETS Station : DECORAH, 192110
Start yr. - 1971 End yr. - 2000
Temperature: 30 years used out of 30 requested in this analysis
Precipitation: 30 years used out of 30 requested in this analysis

	Temperature			Precipitation		
Month	avg daily max	avg daily min	avg	avg (in.)	3 yrs in 10 will have less than (in.)	3 yrs in 10 will have more than (in.)
January	23.7	5.3	14.5	0.74	0.37	0.96
February	29.6	10.7	20.1	0.82	0.44	1.07
March	42.0	23.6	32.8	1.89	1.28	2.42
April	58.2	36.3	47.2	3.42	2.36	4.45
May	70.8	47.7	59.2	3.82	2.96	4.96
June	79.7	56.7	68.2	4.20	2.80	5.46
July	83.7	61.4	72.6	3.99	2.75	5.19
August	81.5	59.0	70.3	4.03	2.55	5.23
September	72.7	50.7	61.7	3.93	2.07	5.11
October	61.0	39.9	50.5	2.27	1.37	2.95
November	43.8	27.0	35.4	1.68	0.89	2.18
December	28.3	12.1	20.2	1.21	0.78	1.57
Yearly :						
Average	56.3	35.9	46.1	---	---	---
Extreme	101	-39	---	---	---	---
Total	---	---	---	32.01	28.58	41.55

GROWING SEASON DATES

WETS Station : DECORAH, 192110
Start yr. - 1971 End yr. - 2000
Requested years of data: 30 Available years of data: 30
Missing data years 24 deg = 1, 28 deg = 1, 32 deg = 1
Years with no occurrence 24 deg = 0, 28 deg = 0, 32 deg = 0
Data years used 24 deg = 29, 28 deg = 29, 32 deg = 29

		Temperature		
Probability		24F	28F	32F
		Growing Season Length Beginning and Ending Dates		
5 years in 10	--	189 days 4/15 to 10/21	161 days 4/31 to 10/ 9	143 days 5/13 to 10/ 2
7 years in 10	--	197 days 4/ 9 to 10/23	170 days 4/24 to 10/12	151 days 5/ 6 to 10/ 4

7 Climatic Data and Conservation Practices [TOC]

The following table provides recommendations on the most appropriate climatic data to use in analysis of the practice for application on a particular field. Values refer to the average or normal values for a particular element and time interval but may refer to a special type of analysis for that time interval ie. probability.

The Practice Names are linked to the appropriate standard which can be retrieved in pdf format by selecting

the practice name.

Practice #	Conservation Practice Applied	Type	Elements prec	temp	evap	wind
560	Access Road		F			
575	Animal Trails and Walkways		F			
310	Bedding		M	M	M	
314	Brush Management		F	M		
322	Channel Vegetation		F	M	M	
324	Chiseling & Subsoiling		M			
326	Clearing & Snagging		M	M		
397	Commercial Fishponds		F	M	M	
317	Composting Facility		M	M	M	M
327	Conservation Cover		F	M	M	
328	Conservation Crop Rotation		M	M	M	R
332	Contour Buffer Strips		F	M	M	
330	Contour Farming		M			
331	Contour Orchard and Other Fruit Area		M	M	M	
335	Controlled Drainage		F	M		
340	Cover & Green Manure Crop		M			
342	Critical Area Planting		F	M	M	M
589A	Cross Wind Ridges		M		M	R
589B	Cross Wind Stripcropping		M		M	R
589C	Cross Wind Trap Strips		F		M	R
348	Dam, Diversion		F		M	
402	Dam, Floodwater Retarding		F		M	
349	Dam, Multiple Purpose		F		M	
356	Dike	Earthen	F		M	
362	Diversion		F		M	
382	Fence		M			M
386	Field Border		M	M	M	
393A	Filter Strip		M	M	M	
394	Firebreak		M	M	M	
398	Fish Raceway or Tank		F	M	M	M
395	Fish Stream Improvement		F	M	M	M
399	Fishpond Management		M	M	M	M
400	Floodwater Diversion		F		M	
404	Floodway		F		M	
511	Forage Harvest Management		M	M	M	
655	Forest Harvest Trails & Landings		F		M	
490	Forest Site Preparation		M		M	M
666	Forest Stand Improvement		M		M	M
410	Grade Stabilization Structure		F		M	
412	Grassed Waterway		F		M	
548	Grazing Land Mechanical Treatment		M	M	M	
561	Heavy Use Area Protection		M	M	M	
422	Hedgerow Planting		M	M	M	
422A	Herbaceous Wind Barriers		M	M	M	R
423	Hillside Ditch		F		M	
320	Irrigation Canal or Lateral		M		M	
388	Irrigation Field Ditch		M		M	
464	Irrigation Land Leveling		M	M		M
552B	Irrigation Pit or Regulating Reservoir	Regulating Reservoir	M		M	
552A	Irrigation Pit or Regulating Reservoir	Irrigation Pit	M		M	

436	Irrigation Storage Reservoir		F		M	
442	Irrigation System	Sprinkler	F		F	
447	Irrigation System	Tailwater Recovery	F			
441	Irrigation System	Trickle	M	M	M	
443	Irrigation System	Surface & Subsurface	F	F	F	
430	Irrigation Water Conveyance	Pipeline	F		M	
428	Irrigation Water Conveyance	Ditch and Canal Lining	M	M		
449	Irrigation Water Management		FD	D	D	
460	Land Clearing		M		M	
453	Land Reclamation	Landslide Treatment	F		M	M
456	Land Reclamation	Highwall Treatment	F		M	
451	Land Reclamation	Fire Control	F	M	M	M
454	Land Reclamation	Subsidence Treatment	F		M	
455	Land Reclamation	Toxic Discharge Control	F	M	F	M
544	Land Reconstruction	Mine-Current	F		M	
543	Land Reconstruction	Mine-Abandoned	F		M	
466	Land Smoothing		M			
468	Lined Waterway or Outlet		M		M	
634	Manure Transfer		M	M	M	
457	Mine Shaft & Adit Closing		M		M	
482	Mole Drain		M			
484	Mulching		M	M	M	
590	Nutrient Management		M	M	M	
500	Obstruction Removal		M			
582	Open Channel		M		M	
512	Pasture & Hayland Planting		F	M	M	
595A	Pest Management		M			
516	Pipeline		M			
378	Pond		M		M	
521A	Pond Sealing or Lining	Flexible Membrane	M		M	
521B	Pond Sealing or Lining	Soil Dispersant	M	M	M	
521C	Pond Sealing or Lining	Bentonite Sealant	M		M	
521D	Pond Sealing or Lining	Cationic Emulsion-Waterborne Sealant	M	M	M	
521E	Pond Sealing or Lining	Asphalt-Sealed Fabric Liner	M	M	M	
462	Precision Land Forming		M			
338	Prescribed Burning		M	M	M	F
528A	Prescribed Grazing		M	M		
532	Pumped Well Drain		M			
533	Pumping Plant for Water Control		M		M	
550	Range Planting		F	M	M	
562	Recreation Area Improvement		M			
566	Recreation Land Grading & Shaping		M	M	M	
568	Recreation Trail & Walkway		M			
554	Regulating Water in Drainage Systems		M		M	
344	Residue Management	Seasonal	M	M	M	
329B	Residue Management	Mulch Till	M	M	M	
329C	Residue Management	Ridge Till	M			
329A	Residue Managment	No-till & Strip Till	M			
391A	Riparian Forest Buffer		F		M	
555	Rock Barrier		M			
558	Roof Runoff Management		F		M	
557	Row Arrangement		F		M	
570	Runoff Management System		F		M	
350	Sediment Basin		F		M	

571	Soil Salinity Management-Nonirrigated		M	M	M	
572	Spoil Spreading		M			M
574	Spring Development		F		M	
584	Stream Channel Stabilization		F		M	
580	Streambank & Shoreline Protection		F		M	
585	Stripcropping	Contour	M	M	M	
586	Stripcropping	Field	M		M	
587	Structure for Water Control		F		M	
606	Subsurface Drain		H		D	
607	Surface Drainage	Field Ditch	F		M	
608	Surface Drainage	Main or Lateral	F			
609	Surface Roughening		F			
600	Terrace		F		M	
610	Toxic Salt Reduction		F	M	M	M
612	Tree/Shrub Establishment		M	M	D	F
660A	Tree/Shrub Pruning		M	M		
614	Trough or Tank		M		M	
620	Underground Outlet		H		M	
472	Use Exclusion		M			
630	Vertical Drain		M			
312	Waste Management System		M		M	
313	Waste Storage Facility		F	F	F	
359	Waste Treatment Lagoon		F		M	
633	Waste Utilization		FD	M	M	
636	Water Harvesting Catchment		F		M	
641	Water Table Control		F		M	
638	Water & Sediment Control Basin		F	M	M	
640	Waterspreading		M		M	
642	Well		M		M	
351	Well Decommissioning		M			
657	Wetland Development or Restoration		F	M	M	
645	Wildlife Upland Habitat Management		M	M		
648	Wildlife Watering Facility		F	M		
644	Wildlife Wetland Habitat Management		M	M		
380	Windbreak/Shelterbelt Establishment		F	M	M	
650	Windbreak/Shelterbelt Renovation		F	M	M	

M=monthly, D=daily, H=hourly, 15=15 minute, F=frequency, R=roses

prec = Precipitation, temp = Temperature Max & Min, evap = Evaportation, wind = Wind Movement

This page last revised - November 18, 1998

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'Closest Station' Climate Data Retrieval

The high density precipitation archive of volunteer precipitation data in Minnesota and/or the 'summary of the day' data set of the National Weather Service Cooperative program are searched for data which is closest to the target location. Values from the sites closest to your target along location information for each month of data are returned to you at the bottom of the page. Please be patient, it may take a minute to retrieve your data.

Obtaining Data for Legal Purposes

Target location is Goodhue-Prairie island-Stroms 114N 15W S32
Lat: 44.63010 Lon: 92.64683

set location

☐ retrieve **only** this station: 216822 RED WING DAM 3

1985

years: 2008 to 2008

number of **missing days** allowed per month: 3

retrieve data from the following data sources:

☑ **Precipitation** from *High Density Network*
☑ **Precipitation** from *National Weather Service*
☑ **Temperature** from *National Weather Service*
☑ **Snow** from *National Weather Service*

get monthly get daily

---

return to retrieval selection

State Climatology Office - MnDNR - Waters, 1996-2002
You can send e-mail to the State Climatology Office .

SITE DATA

'Closest Station' Climate Data Retrieval

The data matching your request is at the bottom of this page or should appear there within one minute.

Target location is Lat: 44.63010 Lon: 92.64683

set location

☐ retrieve **only** this station: 216822 RED WING DAM 3

years: 1936 to 2008

number of **missing days** allowed per month: 3

retrieve data from the following data sources:

☐ **Precipitation** from *High Density Network*
☑ **Precipitation** from *National Weather Service*
☑ **Temperature** from *National Weather Service*
☑ **Snow** from *National Weather Service*

get monthly | get daily

needed pre,temp,snow: 0 3 114

Target: lat 44.63010 lon 92.64683

mon	year	cc	tttN	rrW	ss	nnnn	ooooooo	pre	aaaaaa	Tmx	Tmn	aaaaaa	sno	SnD	dis
Jan	1936					216817		.83	219249	17.5	-3.6	216817	7.7	9.5	7 mi.
Feb	1936					216817		2.62	219249	13.9	-11.6	216817	27.9	27.6	7 mi.
Mar	1936					216817		3.02	219249	41.3	22.0	216817	18.8	m	7 mi.
Apr	1936					216817		.90	219249	52.7	30.1	216817	2.5	m	7 mi.
May	1936					216817		3.39	219249	78.0	49.5	216817	0	m	7 mi.
Jun	1936					216817		2.36	219249	80.5	52.7	m	m	m	7 mi.
Jul	1936					216817		.52	219249	96.2	63.9	m	m	m	7 mi.
Aug	1936					216817		3.70	219249	90.4	61.1	m	m	m	7 mi.
Sep	1936					216817		2.52	219249	80.3	52.4	216817	0	m	7 mi.
Oct	1936					216817		.89	219249	60.1	34.5	216817	0	m	7 mi.
Nov	1936					216817		.80	219249	41.8	22.0	216817	1.2	m	7 mi.
Dec	1936					216817		1.74	219249	33.7	12.9	216817	8.9	m	7 mi.
Jan	1937					216822		1.56	219249	19.5	-6.2	216822	15.8	4.3	1 mi.
Feb	1937					216822		.50	219249	25.6	3.2	216822	6.2	7.2	1 mi.
Mar	1937					216822		1.46	219249	39.0	17.2	216822	14.5	3.0	1 mi.
Apr	1937					216822		2.02	219249	55.9	35.5	216822	.9	.2	1 mi.
May	1937					216822		3.94	219249	73.0	47.0	216822	0	m	1 mi.
Jun	1937					216822		2.21	219249	79.6	53.6	m	m	m	1 mi.
Jul	1937					216822		1.45	219249	91.1	60.0	m	m	m	1 mi.
Aug	1937					216822		2.75	219249	92.4	64.5	m	m	m	1 mi.
Sep	1937					216822		1.71	219249	79.5	49.7	216822	0	m	1 mi.
Oct	1937					216822		1.89	219249	59.5	35.8	216822	0	0	1 mi.
Nov	1937					216822		.19	217386	40.6	23.9	216817	1.5	.7	1 mi.
Dec	1937					216822		.48	212737	26.1	8.4	216822	7.5	2.5	1 mi.
Jan	1938					216822		.36	212737	21.5	5.7	216822	9.9	4.1	1 mi.
Feb	1938					216822		.77	212737	30.3	13.7	216822	5.0	2.8	1 mi.
Mar	1938					216822		1.62	212737	47.3	27.5	216822	3.2	.7	1 mi.
Apr	1938					216822		3.68	212737	57.7	35.5	216822	0	m	1 mi.
May	1938					216822		9.98	217386	65.7	48.3	216822	0	m	1 mi.

Jun 1938	216822	6.04	219249	77.1	53.1		m		m	1	mi.
Jul 1938	216822	4.49	219249	83.5	60.7		m		m	1	mi.
Aug 1938	216822	3.49	219249	83.9	59.2		m		m	1	mi.
Sep 1938	216822	4.31	219249	74.3	49.1	216822	0		m	1	mi.
Oct 1938	216822	1.26	219249	66.6	40.8	216822	0		m	1	mi.
Nov 1938	216822	1.98	219249	41.2	23.1	216822	1.0		m	1	mi.
Dec 1938	216822	.59	219249	28.4	12.9	216822	15.9		m	1	mi.
Jan 1939	216822	1.13	219249	29.4	12.8	216822	8.7	4.7	1	mi.	
Feb 1939	216822	.76	219249	24.8	-1.2	216822	19.0	9.5	1	mi.	
Mar 1939	216822	.43	219249	40.2	18.6	216822	5.7	7.6	1	mi.	
Apr 1939	216817	2.05	219249	54.5	30.5	216817	1.5		m	7	mi.
May 1939	216822	2.45	219249	77.5	47.5	216822	0		m	1	mi.
Jun 1939	216822	3.08	219249	79.9	55.7		m		m	1	mi.
Jul 1939	216822	2.59	219249	86.3	58.0		m		m	1	mi.
Aug 1939	216822	4.78	219249	82.7	56.0		m		m	1	mi.
Sep 1939	216822	1.85	219249	78.6	50.3	216822	0		m	1	mi.
Oct 1939	216822	1.23	219249	60.3	36.9	216822	0		m	1	mi.
Nov 1939	216822	.42	219249	49.9	21.1	216822	0		m	1	mi.
Dec 1939	216822	.69	219249	37.8	16.0	216822	1.0		m	1	mi.
Jan 1940	216822	.28	219249	14.8	-3.3	216822	5.2	3.0	1	mi.	
Feb 1940	216822	.63	219249	29.1	9.5	216822	8.6	5.4	1	mi.	
Mar 1940	216822	1.62	219249	32.0	15.2	216822	31.0	11.2	1	mi.	
Apr 1940	216822	1.49	219249	54.2	32.4	216822	0		m	1	mi.
May 1940	216822	1.34	217386	66.6	40.9	216822	0		m	1	mi.
Jun 1940	216822	11.44	219249	78.8	54.5		m		m	1	mi.
Jul 1940	216822	3.76	219249	85.5	59.7		m		m	1	mi.
Aug 1940	216822	6.21	219249	77.5	57.6		m		m	1	mi.
Sep 1940	216822	.25	219249	76.4	49.4	216817	0		m	1	mi.
Oct 1940	216822	2.36	219249	64.9	39.2	216817	.5		m	1	mi.
Nov 1940	216822	3.13	219249	36.9	21.6	216822	13.0		m	1	mi.
Dec 1940	216822	1.08	219249	29.8	13.7	216822	19.1	8.3	1	mi.	
Jan 1941	216822	1.29	219249	26.2	9.4	216822	4.9	4.8	1	mi.	
Feb 1941	216822	.64	219249	26.1	4.8	216822	7.8	7.6	1	mi.	
Mar 1941	216822	1.18	219249	36.7	18.1	216822	11.8	8.9	1	mi.	
Apr 1941	216822	2.09	219249	63.8	40.0	216822	0	0	1	mi.	
May 1941	216822	2.60	219249	75.2	49.8	216817	0		m	1	mi.
Jun 1941	216822	3.24	219249	78.1	56.9		m		m	1	mi.
Jul 1941	216822	1.42	219249	84.1	59.5		m		m	1	mi.
Aug 1941	216822	1.44	219249	84.4	57.2		m		m	1	mi.
Sep 1941	216822	3.57	219249	75.4	51.8	216817	0		m	1	mi.
Oct 1941	216822	4.11	219249	61.0	39.3	216817	0		m	1	mi.
Nov 1941	216822	1.63	219249	46.2	27.4	216822	0		m	1	mi.
Dec 1941	216822	.82	219249	35.2	18.1	216822	11.8		m	1	mi.
Jan 1942	216822	.19	219249	28.5	9.8	216822	3.5		m	1	mi.
Feb 1942	216822	.32	219249	26.8	10.9	216822	6.4	1.5	1	mi.	
Mar 1942	216822	3.11	219249	43.5	26.8	216817	3.5		m	1	mi.
Apr 1942	216822	3.24	219249	65.1	38.1	216817	0		m	1	mi.
May 1942	216822	7.52	219249	66.2	43.7	216817	0		m	1	mi.
Jun 1942	216822	6.99	219249	76.8	55.2		m		m	1	mi.
Jul 1942	216822	3.51	219249	81.0	57.4		m		m	1	mi.
Aug 1942	216822	2.29	219249	80.6	58.6		m		m	1	mi.
Sep 1942	216822	10.16	219249	67.5	46.5	216817	0		m	1	mi.
Oct 1942	216822	1.75	219249	60.8	34.8	216822	0		m	1	mi.
Nov 1942	216822	.44	219249	43.6	22.7	216822	5.0		m	1	mi.
Dec 1942	216822	1.94	219249	22.8	5.4	216817	14.0	7.0	1	mi.	
Jan 1943	216822	1.39	219249	18.0	-2.9	216822	23.8	22.0	1	mi.	
Feb 1943	216822	.42	219249	29.6	4.5	216822	6.4	16.9	1	mi.	
Mar 1943	216822	1.34	219249	35.0	13.9	216822	8.2		m	1	mi.
Apr 1943	216822	.91	219249	62.0	30.6	216822	0		m	1	mi.
May 1943	216822	3.10	219249	69.7	42.9	216822	0		m	1	mi.

Jun 1943	216822	5.24	219249	79.4	58.6		m	m	1	mi.
Jul 1943	216822	6.24	219249	83.3	60.0		m	m	1	mi.
Aug 1943	216822	3.81	219249	81.1	58.8		m	m	1	mi.
Sep 1943	216822	2.85	219249	67.9	44.7	216817	0	m	1	mi.
Oct 1943	216822	.86	219249	59.5	33.4	216817	0	m	1	mi.
Nov 1943	216822	1.48	219249	35.7	20.4	216822	8.0	m	1	mi.
Dec 1943	216822	0	219249	32.7	12.8	216822	0	m	1	mi.
Jan 1944	216822	.56	219249	36.2	14.9	216822	2.0	m	1	mi.
Feb 1944	216822	.97	219249	31.3	9.7	216822	5.1	m	1	mi.
Mar 1944	216822	1.27	219249	33.3	18.2	216822	14.9	m	1	mi.
Apr 1944	216822	1.96	219249	50.9	30.3	216822	m	m	1	mi.
May 1944	216822	4.92	219249	71.5	50.6	216822	.8	m	1	mi.
Jun 1944	216822	4.73	219249	80.2	58.1		m	m	1	mi.
Jul 1944	216822	2.78	219249	80.3	55.7		m	m	1	mi.
Aug 1944	216822	2.52	219249	81.4	58.1		m	m	1	mi.
Sep 1944	216822	1.69	219249	71.4	49.1	216822	0	m	1	mi.
Oct 1944	216822	.68	219249	62.9	36.2	216817	0	m	1	mi.
Nov 1944	216822	1.06	219249	44.0	31.7	216822	2.0	m	1	mi.
Dec 1944	216822	.38	219249	26.4	9.5	216822	3.7	.3	1	mi.
Jan 1945	216822	.79	219249	21.4	.7	216822	12.4	5.8	1	mi.
Feb 1945	216822	1.92	219249	28.2	5.9	216822	19.0	12.8	1	mi.
Mar 1945	216822	2.92	219249	50.7	24.9	216822	4.5	m	1	mi.
Apr 1945	216822	3.65	219249	53.9	33.7	216822	12.0	m	1	mi.
May 1945	216822	3.58	219249	63.4	38.8	216822	0	m	1	mi.
Jun 1945	216822	4.38	219249	71.6	48.6		m	m	1	mi.
Jul 1945	216822	9.05	219249	80.0	55.6		m	m	1	mi.
Aug 1945	216822	9.42	219249	80.7	56.0		m	m	1	mi.
Sep 1945	216822	3.14	219249	69.7	46.8	216822	0	m	1	mi.
Oct 1945	216822	.46	219249	60.4	33.7	216822	0	m	1	mi.
Nov 1945	216822	1.31	219249	40.9	23.0	216822	7.0	m	1	mi.
Dec 1945	216822	1.67	219249	21.6	4.7	216822	19.8	4.1	1	mi.
Jan 1946	216822	1.28	219249	26.3	6.0	216822	5.0	6.4	1	mi.
Feb 1946	216822	.81	219249	29.0	8.3	216822	6.9	5.6	1	mi.
Mar 1946	216822	1.38	219249	52.0	32.3	216822	1.2	m	1	mi.
Apr 1946	216822	.69	219249	62.7	35.7	216822	0	m	1	mi.
May 1946	216822	3.14	219249	67.5	40.7	216822	0	m	1	mi.
Jun 1946	216822	7.70	219249	78.7	54.1		m	m	1	mi.
Jul 1946	216822	2.40	219249	84.5	58.3		m	m	1	mi.
Aug 1946	216822	.66	219249	80.4	51.5		m	m	1	mi.
Sep 1946	216822	6.61	219249	70.9	46.5	216817	0	m	1	mi.
Oct 1946	216822	4.82	219249	62.9	39.8	216817	0	m	1	mi.
Nov 1946	216822	1.31	219249	40.3	23.2	216822	1.5	m	1	mi.
Dec 1946	216822	.85	219249	31.0	11.7	216822	6.0	.8	1	mi.
Jan 1947	216822	.55	219249	29.5	11.2	216822	7.2	2.3	1	mi.
Feb 1947	216822	.14	219249	20.5	4.9	216822	1.2	2.6	1	mi.
Mar 1947	216822	.92	219249	35.9	19.9	216822	2.5	m	1	mi.
Apr 1947	216822	3.06	219249	51.5	31.5	216822	3.0	m	1	mi.
May 1947	216822	2.42	219249	64.9	40.3	216817	0	m	1	mi.
Jun 1947	216822	5.46	219249	73.8	52.4		m	m	1	mi.
Jul 1947	216822	1.33	219249	83.7	56.0		m	m	1	mi.
Aug 1947	216822	3.46	219249	89.5	63.9		m	m	1	mi.
Sep 1947	216822	5.30	219249	73.9	50.7	216822	0	m	1	mi.
Oct 1947	216822	1.25	219249	69.2	46.1	216817	0	m	1	mi.
Nov 1947	216822	1.89	219249	34.4	18.4	216817	10.9	m	1	mi.
Dec 1947	216822	.77	219249	26.5	5.8	216822	9.9	8.4	1	mi.
Jan 1948	216822	.09	219249	20.4	-4.0	216822	2.0	8.1	1	mi.
Feb 1948	216822	1.97	219249	25.5	4.3	216822	14.9	7.7	1	mi.
Mar 1948	216822	.97	219249	38.6	14.2	216822	4.5	m	1	mi.
Apr 1948	216822	2.06	219249	63.9	36.7	216822	.8	0	1	mi.
May 1948	216822	1.26	219249	68.9	42.8	216822	0	0	1	mi.

Jun 1948	216822	2.18	219249	77.2	52.5	219249	0	0	1 mi.
Jul 1948	216822	1.51	219249	87.5	59.4	216822	0	0	1 mi.
Aug 1948	216822	3.62	219249	84.1	57.5	216822	0	0	1 mi.
Sep 1948	216822	.51	219249	80.1	50.0	216822	0	0	1 mi.
Oct 1948	216822	.77	219249	62.2	34.5	216817	0	0	1 mi.
Nov 1948	216822	2.11	219249	42.3	29.2	216817	1.0	0	1 mi.
Dec 1948	216822	.90	219249	28.9	9.9	216822	2.0	1.9	1 mi.
Jan 1949	216822	1.36	219249	24.1	5.8	216822	8.5	2.4	1 mi.
Feb 1949	216822	.21	219249	25.5	4.6	216822	4.6	5.2	1 mi.
Mar 1949	216822	3.61	219249	38.7	22.0	216822	5.0	.2	1 mi.
Apr 1949	216822	1.25	219249	58.5	32.4	216822	2.0	.1	1 mi.
May 1949	216822	1.07	219249	74.5	47.5	216822	0	0	1 mi.
Jun 1949	216822	4.28	219249	83.6	58.7	216822	0	0	1 mi.
Jul 1949	216822	7.06	216822	86.4	66.3	216822	0	0	1 mi.
Aug 1949	216822	1.83	219249	86.1	58.9	216822	0	0	1 mi.
Sep 1949	216822	1.15	219249	71.0	44.7	216822	0	0	1 mi.
Oct 1949	216822	2.53	216822	64.7	43.9	216817	0	0	1 mi.
Nov 1949	216822	.64	216822	46.4	29.9	216822	3.3	.2	1 mi.
Dec 1949	216822	1.39	216822	31.3	12.8	216822	8.1	.4	1 mi.
Jan 1950	216822	1.44	216822	20.5	-3.7	216822	22.3	6.9	1 mi.
Feb 1950	216822	.90	216822	26.5	.3	216822	10.6	11.4	1 mi.
Mar 1950	216822	2.12	219249	32.5	15.6	216822	6.1	5.3	1 mi.
Apr 1950	216822	2.68	219249	47.6	29.0	216822	2.1	0	1 mi.
May 1950	216822	2.09	219249	67.2	44.6	216822	0	0	1 mi.
Jun 1950	216822	7.57	219249	80.2	54.0	216822	0	0	1 mi.
Jul 1950	216822	3.44	219249	81.7	55.6	216822	0	0	1 mi.
Aug 1950	216822	2.94	219249	78.2	53.4	216822	0	0	1 mi.
Sep 1950	216822	1.93	219249	73.1	47.9	216822	0	0	1 mi.
Oct 1950	216822	1.21	219249	67.2	40.6	216822	0	0	1 mi.
Nov 1950	216822	1.01	219249	39.3	18.3	216822	6.5	.6	1 mi.
Dec 1950	216822	1.72	219249	22.5	1.1	216822	21.5	13.7	1 mi.
Jan 1951	216822	.52	219249	20.1	-3.8	216822	8.9	16.1	1 mi.
Feb 1951	216822	1.45	219249	27.7	6.3	216822	4.5	17.1	1 mi.
Mar 1951	216822	3.36	219249	30.8	10.8	216822	44.6	20.0	1 mi.
Apr 1951	216822	2.75	219249	50.0	31.8	216822	2.9	2.0	1 mi.
May 1951	216822	2.11	219249	73.8	47.8	216822	0	0	1 mi.
Jun 1951	216822	6.60	219249	75.6	51.7	216822	0	0	1 mi.
Jul 1951	216822	4.08	219249	83.4	58.5	216822	0	0	1 mi.
Aug 1951	216822	3.31	219249	78.5	56.5	216822	0	0	1 mi.
Sep 1951	216822	5.18	219249	69.3	45.6	216822	0	0	1 mi.
Oct 1951	216822	1.35	219249	60.0	39.1	216822	0	0	1 mi.
Nov 1951	216822	1.90	219249	35.9	14.8	216822	10.8	1.4	1 mi.
Dec 1951	216822	1.10	219249	24.9	8.3	216822	12.5	2.9	1 mi.
Jan 1952	216822	1.22	219249	26.6	2.4	216822	11.6	7.2	1 mi.
Feb 1952	216822	.65	219249	33.2	15.2	216822	14.2	10.3	1 mi.
Mar 1952	216822	1.71	219249	34.6	16.5	216822	22.8	11.5	1 mi.
Apr 1952	216822	1.52	219249	60.5	34.1	216822	2.0	.6	1 mi.
May 1952	216822	3.71	219249	69.8	44.5	216822	0	0	1 mi.
Jun 1952	216822	6.32	219249	81.6	57.4	216822	0	0	1 mi.
Jul 1952	216822	3.75	219249	86.3	59.2	216822	0	0	1 mi.
Aug 1952	216822	5.55	219249	81.1	56.1	216822	0	0	1 mi.
Sep 1952	216822	.38	219249	76.3	47.2	216822	0	0	1 mi.
Oct 1952	216822	.03	219249	59.7	27.0	216822	0	0	1 mi.
Nov 1952	216822	1.20	219249	47.9	23.0	216822	12.3	.9	1 mi.
Dec 1952	216822	.39	219249	30.3	13.0	216822	7.5	4.6	1 mi.
Jan 1953	216822	.81	219249	27.4	7.6	216822	3.4	5.8	1 mi.
Feb 1953	216822	1.47	219249	30.4	8.4	216822	21.4	9.1	1 mi.
Mar 1953	216822	1.12	219249	41.0	21.0	216822	4.3	5.9	1 mi.
Apr 1953	216822	3.34	219249	50.7	30.6	216822	0	0	1 mi.
May 1953	216822	2.34	219249	70.6	47.1	216822	0	0	1 mi.

Jun 1953	216822	5.29	219249	81.6	59.3	216822	0	0	1 mi.
Jul 1953	216822	5.95	219249	82.8	59.1	216822	0	0	1 mi.
Aug 1953	216822	3.95	219249	84.0	59.3	216822	0	0	1 mi.
Sep 1953	216822	.58	219249	76.7	46.5	216822	0	0	1 mi.
Oct 1953	216822	.05	217107	70.3	41.1	216822	0	0	1 mi.
Nov 1953	216822	1.58	219249	51.6	25.9	216822	.2	0	1 mi.
Dec 1953	216822	1.40	219249	33.1	12.7	216822	9.1	2.8	1 mi.
Jan 1954	216822	.24	219249	24.4	1.6	216822	5.2	4.5	1 mi.
Feb 1954	216822	.42	219249	43.5	23.6	216822	0	.6	1 mi.
Mar 1954	216822	1.95	219249	40.0	18.2	216822	9.6	1.0	1 mi.
Apr 1954	216822	5.34	219249	62.0	35.8	216822	0	0	1 mi.
May 1954	216822	4.14	219249	64.9	42.1	216822	2.2	0	1 mi.
Jun 1954	216822	7.71	219249	81.1	57.7	216822	0	0	1 mi.
Jul 1954	216822	4.96	219249	85.7	61.6	216822	0	0	1 mi.
Aug 1954	216822	2.94	219249	81.7	56.6	216822	0	0	1 mi.
Sep 1954	216822	4.66	219249	73.7	51.0	216822	0	0	1 mi.
Oct 1954	216822	3.77	219249	58.0	38.3	216822	0	0	1 mi.
Nov 1954	216822	.66	219249	47.3	28.9	216822	4.0	.3	1 mi.
Dec 1954	216822	.85	219249	30.3	15.0	216822	14.8	6.2	1 mi.
Jan 1955	216822	.55	219249	24.5	4.4	216822	10.1	9.0	1 mi.
Feb 1955	216822	1.10	219249	25.9	4.0	216822	9.0	12.7	1 mi.
Mar 1955	216822	1.07	219249	38.7	15.0	216822	8.6	4.2	1 mi.
Apr 1955	216822	2.59	219249	66.7	39.5	216822	0	0	1 mi.
May 1955	216822	1.59	219249	76.2	48.3	216822	0	0	1 mi.
Jun 1955	216822	3.17	219249	78.4	54.4	216822	0	0	1 mi.
Jul 1955	216822	7.59	219249	89.1	66.5	216822	0	0	1 mi.
Aug 1955	216822	3.37	219249	87.3	62.1	216822	0	0	1 mi.
Sep 1955	216822	1.15	219249	76.8	49.4	216822	0	0	1 mi.
Oct 1955	216822	1.91	219249	64.3	38.7	216822	0	0	1 mi.
Nov 1955	216822	1.24	219249	35.9	19.5	216822	6.4	1.3	1 mi.
Dec 1955	216822	1.22	219249	23.8	3.6	216822	15.0	5.4	1 mi.
Jan 1956	216822	.39	219249	22.8	1.9	216822	5.0	7.6	1 mi.
Feb 1956	216822	.25	219249	27.7	1.6	216822	3.8	7.9	1 mi.
Mar 1956	216822	2.81	219249	36.7	14.8	216822	22.3	8.3	1 mi.
Apr 1956	216822	1.35	219249	56.4	29.2	216822	7.7	.5	1 mi.
May 1956	216822	3.08	219249	70.4	45.4	216822	0	0	1 mi.
Jun 1956	216822	7.02	219249	84.6	58.7	216822	0	0	1 mi.
Jul 1956	216822	3.97	219249	80.8	57.1	216822	0	0	1 mi.
Aug 1956	216822	6.84	219249	82.8	57.7	216822	0	0	1 mi.
Sep 1956	216822	.83	219249	73.3	44.7	216822	0	0	1 mi.
Oct 1956	216822	1.41	219249	69.9	42.7	216822	0	0	1 mi.
Nov 1956	216822	1.23	219249	43.6	22.5	216822	8.2	1.9	1 mi.
Dec 1956	216822	.25	219249	34.7	15.2	216822	3.9	.8	1 mi.
Jan 1957	216822	.24	219249	22.8	1.5	216822	4.1	.9	1 mi.
Feb 1957	216822	.69	219249	34.0	10.4	216822	8.4	2.9	1 mi.
Mar 1957	216822	1.12	219249	41.2	20.9	216822	7.2	.5	1 mi.
Apr 1957	216822	1.01	219249	59.2	34.6	216822	6.9	.3	1 mi.
May 1957	216822	4.76	219249	69.9	43.4	216822	0	0	1 mi.
Jun 1957	216822	5.15	219249	79.5	54.7	216822	0	0	1 mi.
Jul 1957	216822	8.47	219249	86.6	63.4	216822	0	0	1 mi.
Aug 1957	216822	5.21	219249	80.0	57.7	216822	0	0	1 mi.
Sep 1957	216822	1.48	219249	72.0	46.3	216822	0	0	1 mi.
Oct 1957	216822	1.99	217107	57.2	36.1	216822	0	0	1 mi.
Nov 1957	216822	2.47	219249	42.2	26.2	216822	13.5	2.7	1 mi.
Dec 1957	216822	.64	219249	34.1	15.5	216822	3.8	1.5	1 mi.
Jan 1958	216822	.21	219249	29.9	13.8	216822	3.4	1.0	1 mi.
Feb 1958	216822	.09	219249	25.8	4.0	216822	.8	2.4	1 mi.
Mar 1958	216822	.36	217107	40.4	21.5	216822	4.3	.5	1 mi.
Apr 1958	216822	2.27	219249	59.3	33.2	216822	0	0	1 mi.
May 1958	216822	1.13	219249	74.8	45.0	216822	0	0	1 mi.

Jun 1958	216822	4.67	219249	75.4	49.9	216822	0	0	1 mi.
Jul 1958	216822	3.95	219249	80.1	55.8	216822	0	0	1 mi.
Aug 1958	216822	2.04	219249	83.7	56.8	216822	0	0	1 mi.
Sep 1958	216822	2.65	219249	74.4	50.1	216822	0	0	1 mi.
Oct 1958	216822	1.87	219249	66.4	40.2	216822	0	0	1 mi.
Nov 1958	216822	.74	217107	45.3	23.2	216822	1.5	0	1 mi.
Dec 1958	216822	.19	219249	25.3	3.1	216822	3.1	1.1	1 mi.
Jan 1959	216822	.22	219249	21.1	-1.2	216822	4.3	1.9	1 mi.
Feb 1959	216822	.57	219249	26.6	2.3	216822	11.7	3.9	1 mi.
Mar 1959	216822	1.07	219249	42.6	20.8	216822	8.3	1.4	1 mi.
Apr 1959	216822	1.44	219249	60.2	34.1	216822	0	0	1 mi.
May 1959	216822	5.89	219249	72.8	48.8	216822	0	0	1 mi.
Jun 1959	216822	2.83	219249	81.3	56.2	216822	0	0	1 mi.
Jul 1959	216822	2.57	219249	84.5	59.5	216822	0	0	1 mi.
Aug 1959	216822	7.01	219249	85.7	63.8	216822	0	0	1 mi.
Sep 1959	216822	4.70	219249	74.2	50.4	216822	0	0	1 mi.
Oct 1959	216822	2.87	219249	54.9	35.4	216822	2.1	0	1 mi.
Nov 1959	216822	.72	219249	33.9	16.1	216822	6.1	.6	1 mi.
Dec 1959	216822	1.90	219249	38.4	21.6	216822	5.1	.5	1 mi.
Jan 1960	216822	.44	219249	27.2	9.9	216822	6.3	1.2	1 mi.
Feb 1960	216822	.47	219249	29.3	9.5	216822	6.1	1.3	1 mi.
Mar 1960	216822	.67	219249	32.6	8.2	216822	6.1	2.0	1 mi.
Apr 1960	216822	3.11	219249	59.0	34.8	216822	0	0	1 mi.
May 1960	216822	4.93	219249	69.8	46.2	216822	0	0	1 mi.
Jun 1960	216822	4.93	219249	76.5	53.5	216822	0	0	1 mi.
Jul 1960	216822	1.33	219249	84.3	58.5	216822	0	0	1 mi.
Aug 1960	216822	3.75	219249	84.6	59.8	216822	0	0	1 mi.
Sep 1960	216822	4.29	219249	74.6	53.1	216822	0	0	1 mi.
Oct 1960	216822	.95	219249	63.4	35.9	216822	0	0	1 mi.
Nov 1960	216822	1.47	219249	47.4	26.1	216822	.3	0	1 mi.
Dec 1960	216822	.72	219249	29.2	9.1	216822	.7	0	1 mi.
Jan 1961	216822	.16	219249	26.8	5.9	216822	5.5	.6	1 mi.
Feb 1961	216822	1.61	219249	37.4	15.0	216822	13.5	3.0	1 mi.
Mar 1961	216822	2.07	219249	43.4	23.7	216822	13.0	2.6	1 mi.
Apr 1961	216822	1.61	219249	51.5	29.6	216822	3.6	.1	1 mi.
May 1961	216822	4.24	219249	69.8	41.8	216822	0	0	1 mi.
Jun 1961	216822	2.01	219249	81.9	55.1	216822	0	0	1 mi.
Jul 1961	216822	3.95	219249	83.2	58.1	216822	0	0	1 mi.
Aug 1961	216822	2.60	219249	83.7	58.6	216822	0	0	1 mi.
Sep 1961	216822	3.13	219249	72.8	49.7	216822	0	0	1 mi.
Oct 1961	216822	2.90	219249	65.5	37.6	216822	0	0	1 mi.
Nov 1961	216822	1.31	219249	42.8	25.4	216822	1.5	0	1 mi.
Dec 1961	216822	1.30	219249	26.1	8.7	216822	24.0	8.7	1 mi.
Jan 1962	216822	.52	219249	20.8	.3	216822	8.0	7.9	1 mi.
Feb 1962	216822	1.14	219249	23.4	5.7	216822	27.9	12.5	1 mi.
Mar 1962	216822	1.25	219249	36.3	14.9	216822	20.6	17.2	1 mi.
Apr 1962	216822	2.08	219249	56.5	30.3	216822	7.0	.4	1 mi.
May 1962	216822	4.97	219249	73.7	50.9	216822	0	0	1 mi.
Jun 1962	216822	2.42	219249	78.0	54.2	216822	0	0	1 mi.
Jul 1962	216822	4.16	219249	80.0	57.7	216822	0	0	1 mi.
Aug 1962	216822	4.65	219249	83.4	56.1	216822	0	0	1 mi.
Sep 1962	216822	3.00	219249	70.3	44.5	216822	0	0	1 mi.
Oct 1962	216822	2.24	219249	64.7	40.1	216822	0	0	1 mi.
Nov 1962	216822	.46	219249	47.1	27.7	216822	3.8	.3	1 mi.
Dec 1962	216822	.28	219249	32.1	11.6	216822	2.3	.5	1 mi.
Jan 1963	216822	.78	219249	15.2	-3.2	216822	8.7	4.8	1 mi.
Feb 1963	216822	.44	219249	27.1	5.1	216822	5.4	4.2	1 mi.
Mar 1963	216822	1.37	219249	46.7	23.2	216822	10.6	2.7	1 mi.
Apr 1963	216822	1.69	219249	63.3	35.1	216822	2.0	0	1 mi.
May 1963	216822	1.87	219249	69.9	44.4	216822	0	0	1 mi.

Jun 1963	216822	2.52	219249	84.0	56.1	216822	0	0	1 mi.
Jul 1963	216822	1.90	219249	85.6	59.5	216822	0	0	1 mi.
Aug 1963	216822	1.81	219249	83.1	55.7	216822	0	0	1 mi.
Sep 1963	216822	4.30	219249	76.9	50.2	216822	0	0	1 mi.
Oct 1963	216822	.82	219249	73.5	46.2	216822	0	0	1 mi.
Nov 1963	216822	.90	219249	49.9	29.1	216822	.5	0	1 mi.
Dec 1963	216822	.50	219249	20.9	2.7	216822	8.0	2.1	1 mi.
Jan 1964	216822	.39	219249	33.5	13.0	216822	7.3	2.9	1 mi.
Feb 1964	216822	.03	219249	38.9	14.0	216822	0	.2	1 mi.
Mar 1964	216822	1.59	219249	40.3	18.5	216822	11.2	1.1	1 mi.
Apr 1964	216822	4.71	219249	60.0	35.1	216822	1.0	0	1 mi.
May 1964	216822	4.35	219249	76.7	47.9	216822	0	0	1 mi.
Jun 1964	216822	1.24	219249	82.9	54.0	216822	0	0	1 mi.
Jul 1964	216822	4.80	219249	89.9	62.1	216822	0	0	1 mi.
Aug 1964	216822	3.80	219249	82.8	53.4	216822	0	0	1 mi.
Sep 1964	216822	7.50	219249	72.4	47.1	216822	0	0	1 mi.
Oct 1964	216822	1.24	219249	63.4	35.9	216822	0	0	1 mi.
Nov 1964	216822	1.07	219249	47.7	25.8	216822	2.0	.2	1 mi.
Dec 1964	216822	1.46	219249	25.4	8.3	216822	10.0	2.5	1 mi.
Jan 1965	216822	.45	219249	22.6	.1	216822	9.6	4.5	1 mi.
Feb 1965	216822	1.41	219249	24.0	.3	216822	19.7	10.1	1 mi.
Mar 1965	216822	2.89	219249	30.5	9.4	216822	27.6	9.8	1 mi.
Apr 1965	216822	3.29	219249	52.9	33.6	216822	2.9	2.5	1 mi.
May 1965	216822	5.72	219249	73.5	48.0	216822	0	0	1 mi.
Jun 1965	216822	3.06	219249	79.4	54.1	216822	0	0	1 mi.
Jul 1965	216822	6.48	219249	83.6	58.8	216822	0	0	1 mi.
Aug 1965	216822	3.32	219249	81.6	56.3	216822	0	0	1 mi.
Sep 1965	216822	4.94	213567	62.2	48.8	216822	0	0	1 mi.
Oct 1965	216822	1.28	219249	65.8	39.3	216822	0	0	1 mi.
Nov 1965	216822	2.09	219249	44.5	24.5	216822	0	0	1 mi.
Dec 1965	216822	1.12	219249	36.6	22.7	216817	0	.2	1 mi.
Jan 1966	216822	.90	219249	15.3	-5.7	216822	11.4	6.0	1 mi.
Feb 1966	216822	1.08	219249	29.1	3.2	216822	7.0	3.4	1 mi.
Mar 1966	216822	2.31	219249	48.5	25.5	216822	12.0	1.9	1 mi.
Apr 1966	216822	1.84	219249	55.6	32.4	216822	0	0	1 mi.
May 1966	216822	1.24	219249	69.8	39.5	216822	0	0	1 mi.
Jun 1966	216822	3.44	219249	82.7	54.7	216822	0	0	1 mi.
Jul 1966	216822	3.52	219249	88.9	61.3	216822	0	0	1 mi.
Aug 1966	216822	4.89	219249	80.5	54.0	216822	0	0	1 mi.
Sep 1966	216822	2.28	219249	74.3	46.3	216822	0	0	1 mi.
Oct 1966	216822	2.53	219249	60.8	34.5	216822	0	0	1 mi.
Nov 1966	216822	.41	219249	40.3	22.3	216822	2.3	.2	1 mi.
Dec 1966	216822	1.00	219249	28.0	10.6	216822	9.8	1.0	1 mi.
Jan 1967	216822	2.68	213567	26.3	6.4	216822	26.0	11.1	1 mi.
Feb 1967	216822	.70	213567	21.2	-.8	216822	14.5	17.5	1 mi.
Mar 1967	216822	1.09	219249	40.8	20.4	216822	5.0	11.2	1 mi.
Apr 1967	216822	5.23	219249	55.9	35.6	216822	0	0	1 mi.
May 1967	216822	1.77	219249	65.5	38.7	216822	0	0	1 mi.
Jun 1967	216822	6.37	219249	79.2	55.1	216822	0	0	1 mi.
Jul 1967	216822	2.36	216822	80.6	61.2	216822	0	0	1 mi.
Aug 1967	216822	1.44	219249	79.5	52.5	216822	0	0	1 mi.
Sep 1967	216822	.82	219249	73.8	45.8	216822	0	0	1 mi.
Oct 1967	216822	2.15	219249	58.9	35.5	216822	0	0	1 mi.
Nov 1967	216822	.12	213567	40.8	26.0	216822	0	0	1 mi.
Dec 1967	216822	.13	219249	32.2	14.2	216822	0	0	1 mi.
Jan 1968	216822	.45	219249	24.9	5.3	216822	4.6	1.4	1 mi.
Feb 1968	216822	.06	214438	11.8	5.3	216822	.7	.1	1 mi.
Mar 1968	216822	.99	216822	52.4	28.2	216822	0	0	1 mi.
Apr 1968	216822	3.58	217107	62.3	36.7	216822	0	0	1 mi.
May 1968	216822	5.80	216822	65.6	45.2	216822	0	0	1 mi.

Jun 1968	216822	5.66	216822	78.4	58.7	216822	0	0	1 mi.
Jul 1968	216822	6.73	219249	83.2	57.8	216822	0	0	1 mi.
Aug 1968	216822	1.41	219249	82.7	57.3	216822	0	0	1 mi.
Sep 1968	216822	5.51	219249	71.8	49.2	216822	0	0	1 mi.
Oct 1968	216822	4.14	219249	62.5	40.4	216822	0	0	1 mi.
Nov 1968	216822	.68	219249	41.8	26.3	213567	0	0	1 mi.
Dec 1968	216822	2.16	219249	27.2	9.7	216822	27.4	6.0	1 mi.
Jan 1969	216822	2.30	219249	19.1	-.1	216822	22.0	18.3	1 mi.
Feb 1969	216822	.28	219249	28.4	9.2	216822	5.0	21.3	1 mi.
Mar 1969	216822	2.28	213567	35.7	20.0	216817	6.5	15.6	1 mi.
Apr 1969	216822	1.12	216822	59.3	40.4	216822	0	0	1 mi.
May 1969	216822	2.00	216822	71.8	50.8	216822	0	0	1 mi.
Jun 1969	216822	4.97	219249	72.6	48.4	216822	0	0	1 mi.
Jul 1969	216822	5.36	219249	83.6	60.6	216822	0	0	1 mi.
Aug 1969	216822	1.02	219249	86.2	58.1	216822	0	0	1 mi.
Sep 1969	216822	.99	216822	74.7	51.2	216822	0	0	1 mi.
Oct 1969	216822	3.05	216822	55.4	39.0	216822	0	0	1 mi.
Nov 1969	216822	.75	219249	42.1	24.8	216817	2.5	.2	1 mi.
Dec 1969	216822	1.76	216822	28.4	13.9	216817	31.4	9.0	1 mi.
Jan 1970	216822	.65	216822	15.3	-3.4	216822	10.9	14.2	1 mi.
Feb 1970	216822	.09	213567	28.9	5.2	216822	1.1	12.2	1 mi.
Mar 1970	216822	1.78	213567	36.5	19.8	216822	5.5	8.3	1 mi.
Apr 1970	216822	2.36	219249	57.1	33.2	216822	0	.6	1 mi.
May 1970	216822	6.39	213567	69.2	51.5	216822	0	0	1 mi.
Jun 1970	216822	3.30	219249	81.4	56.8	216822	0	0	1 mi.
Jul 1970	216822	3.05	216822	85.9	61.8	216822	0	0	1 mi.
Aug 1970	216822	1.30	219249	83.5	54.7	216822	0	0	1 mi.
Sep 1970	216822	4.52	216822	70.9	51.6	216822	0	0	1 mi.
Oct 1970	216822	6.26	219249	60.9	38.6	216822	0	0	1 mi.
Nov 1970	216822	2.67	216822	40.5	26.6	216822	5.0	.6	1 mi.
Dec 1970	216822	.58	219249	28.2	7.9	216822	13.0	3.7	1 mi.
Jan 1971	216822	.94	216822	16.5	-2.3	216822	14.1	11.6	1 mi.
Feb 1971	216822	.97	472556	25.0	9.4	216822	12.6	16.2	1 mi.
Mar 1971	216822	.60	216822	36.4	20.2	216822	1.9	11.3	1 mi.
Apr 1971	216822	.80	219249	60.7	31.6	216822	.6	.4	1 mi.
May 1971	216822	3.10	472556	67.7	44.3	216822	0	0	1 mi.
Jun 1971	216822	5.18	216822	82.1	62.4	216822	0	0	1 mi.
Jul 1971	216822	3.51	472556	79.2	57.9	216822	0	0	1 mi.
Aug 1971	216822	.95	216822	81.5	57.6	216822	0	0	1 mi.
Sep 1971	216822	4.06	216822	73.6	53.2	216822	0	0	1 mi.
Oct 1971	216822	4.06	472556	62.7	45.3	216822	0	0	1 mi.
Nov 1971	216822	2.02	472556	40.0	27.5	216822	5.9	.7	1 mi.
Dec 1971	216822	.64	472556	25.8	11.2	216822	11.6	4.0	1 mi.
Jan 1972	216822	.72	472556	16.4	-2.5	216822	11.9	9.4	1 mi.
Feb 1972	216822	.32	219249	22.9	.2	216822	2.9	14.2	1 mi.
Mar 1972	216822	.89	472556	34.9	18.1	216822	9.0	9.2	1 mi.
Apr 1972	216822	2.06	472556	51.8	32.5	216822	2.0	.1	1 mi.
May 1972	216822	1.95	472556	73.1	51.4	216822	0	0	1 mi.
Jun 1972	216822	3.00	472556	79.0	55.1	216822	0	0	1 mi.
Jul 1972	216822	8.50	216822	80.7	59.9	216822	0	0	1 mi.
Aug 1972	216822	2.88	472556	80.2	60.4	216822	0	0	1 mi.
Sep 1972	216822	3.73	472556	69.1	49.5	216822	0	0	1 mi.
Oct 1972	216822	2.86	472556	53.8	36.0	216822	0	0	1 mi.
Nov 1972	216822	1.35	472556	36.9	26.2	216822	0	0	1 mi.
Dec 1972	216822	1.43	472556	19.9	4.9	216822	12.3	5.5	1 mi.
Jan 1973	216822	.92	472556	26.4	9.7	216822	7.0	9.1	1 mi.
Feb 1973	216822	.92	219249	30.5	10.4	216822	13.0	13.2	1 mi.
Mar 1973	216822	1.92	472556	46.8	32.2	216822	0	3.1	1 mi.
Apr 1973	216822	2.40	472556	54.1	35.5	216822	2.0	.1	1 mi.
May 1973	216822	6.17	472556	65.6	45.2	216822	0	0	1 mi.

Jun 1973	216822	2.30	472556	79.5	58.5	216822	0	0	1 mi.
Jul 1973	216822	4.06	472556	83.1	62.0	216822	0	0	1 mi.
Aug 1973	216822	4.80	472556	82.0	61.9	216822	0	0	1 mi.
Sep 1973	216822	2.67	472556	69.6	51.4	216822	0	0	1 mi.
Oct 1973	216822	1.97	472556	64.5	45.0	216822	0	0	1 mi.
Nov 1973	216822	1.77	472556	41.2	26.1	216822	0	0	1 mi.
Dec 1973	216822	.69	472556	23.9	9.7	216822	8.0	3.2	1 mi.
Jan 1974	216822	.14	472556	22.7	5.4	216822	.3	5.5	1 mi.
Feb 1974	216822	.87	472556	27.8	8.8	216822	12.5	9.9	1 mi.
Mar 1974	216822	.78	472556	38.5	21.0	216822	10.5	1.5	1 mi.
Apr 1974	216822	3.08	472556	57.8	35.4	216822	6.0	.3	1 mi.
May 1974	216822	3.42	219249	65.5	44.3	216822	0	0	1 mi.
Jun 1974	216822	4.40	219249	77.1	54.1	216822	0	0	1 mi.
Jul 1974	216822	1.36	472556	88.2	64.4	216822	0	0	1 mi.
Aug 1974	216822	2.93	472556	78.6	57.0	216822	0	0	1 mi.
Sep 1974	216822	.89	472556	69.2	45.3	216822	0	0	1 mi.
Oct 1974	216822	.84	472556	61.6	40.3	216822	0	0	1 mi.
Nov 1974	216822	1.00	472556	42.3	26.9	216822	1.0	0	1 mi.
Dec 1974	216822	.44	472556	30.3	17.4	216822	3.1	1.5	1 mi.
Jan 1975	216822	2.65	472556	23.4	6.3	216822	19.5	7.3	1 mi.
Feb 1975	216822	.62	472556	25.2	8.7	216822	10.8	15.2	1 mi.
Mar 1975	216822	1.53	472556	32.0	13.8	216822	16.5	14.2	1 mi.
Apr 1975	216822	6.62	472556	47.0	28.5	216822	1.0	5.0	1 mi.
May 1975	216822	4.25	472556	71.3	50.1	216822	0	0	1 mi.
Jun 1975	216822	7.53	472556	77.0	57.1	216822	0	0	1 mi.
Jul 1975	216822	1.76	472556	86.3	63.3	216822	0	0	1 mi.
Aug 1975	216822	5.60	472556	80.8	59.1	216822	0	0	1 mi.
Sep 1975	216822	1.57	472556	67.4	46.0	216822	0	0	1 mi.
Oct 1975	216822	.31	472556	63.9	40.6	216822	0	0	1 mi.
Nov 1975	216822	4.76	472556	48.1	28.1	216822	2.6	.7	1 mi.
Dec 1975	216822	1.24	472556	26.4	12.1	216822	2.8	1.0	1 mi.
Jan 1976	216822	.76	472556	20.9	.2	216822	8.9	4.9	1 mi.
Feb 1976	216822	.59	472556	35.3	16.0	216822	3.0	3.7	1 mi.
Mar 1976	216822	2.79	472556	41.1	22.1	216822	7.1	1.0	1 mi.
Apr 1976	216822	2.13	216822	62.3	40.6	216822	0	0	1 mi.
May 1976	216822	1.31	216822	70.5	44.6	216822	0	0	1 mi.
Jun 1976	216822	3.31	472556	82.7	56.4	216822	0	0	1 mi.
Jul 1976	216822	3.29	472556	87.4	61.2	216822	0	0	1 mi.
Aug 1976	216822	1.15	472556	83.4	58.2	216822	0	0	1 mi.
Sep 1976	216822	2.22	472556	73.9	47.4	216822	0	0	1 mi.
Oct 1976	216822	.43	472556	54.8	32.5	472556	2.0	0	1 mi.
Nov 1976	216822	0	472556	36.4	16.6	216822	0	0	1 mi.
Dec 1976	216822	.35	472556	19.9	-.3	216822	3.5	2.6	1 mi.
Jan 1977	216822	.49	472556	9.3	-9.2	216822	11.3	6.5	1 mi.
Feb 1977	216822	.67	472556	30.6	12.8	216822	2.5	5.2	1 mi.
Mar 1977	216822	2.57	216822	47.5	30.5	216822	8.0	2.1	1 mi.
Apr 1977	216822	2.93	472556	65.3	41.6	216822	0	0	1 mi.
May 1977	216822	3.69	472556	79.5	54.8	216822	0	0	1 mi.
Jun 1977	216822	4.37	472556	79.0	56.4	216822	0	0	1 mi.
Jul 1977	216822	3.29	216822	85.5	64.6	216822	0	0	1 mi.
Aug 1977	216822	3.45	472556	77.9	55.4	216822	0	0	1 mi.
Sep 1977	216822	5.14	472556	70.6	51.2	216822	0	0	1 mi.
Oct 1977	216822	3.73	472556	57.9	37.5	216822	0	0	1 mi.
Nov 1977	216822	1.11	472556	39.9	23.8	216822	8.0	1.2	1 mi.
Dec 1977	216822	1.61	472556	21.3	7.3	216822	8.5	5.5	1 mi.
Jan 1978	216822	.49	472556	15.7	-2.0	216822	13.0	9.1	1 mi.
Feb 1978	216822	.20	472556	21.8	1.5	216822	4.6	10.4	1 mi.
Mar 1978	216822	.32	472556	38.0	14.1	216822	5.0	8.5	1 mi.
Apr 1978	216822	3.76	472556	55.6	33.7	216822	0	0	1 mi.
May 1978	216822	3.35	216822	73.2	50.0	216822	0	0	1 mi.

Jun 1978	216822	4.57	472556	78.4	54.4	216822	0	0	1 mi.
Jul 1978	216822	9.69	472556	80.7	59.1	216822	0	0	1 mi.
Aug 1978	216822	2.91	219249	83.3	56.7	216822	0	0	1 mi.
Sep 1978	216822	3.64	219249	78.9	51.7	216822	0	0	1 mi.
Oct 1978	216822	.41	219249	60.8	36.1	216822	0	0	1 mi.
Nov 1978	216822	1.69	219249	41.0	19.1	216822	15.2	3.1	1 mi.
Dec 1978	216822	.83	219249	22.8	3.6	216822	11.2	10.9	1 mi.
Jan 1979	216822	.67	219249	10.5	-9.3	216822	17.0	18.2	1 mi.
Feb 1979	216822	.51	219249	20.2	-3.6	216822	6.5	23.6	1 mi.
Mar 1979	216822	2.80	219249	36.0	18.7	216822	2.5	15.0	1 mi.
Apr 1979	216822	1.35	219249	53.1	30.1	216822	.3	.6	1 mi.
May 1979	216822	2.88	219249	68.9	40.5	216822	0	0	1 mi.
Jun 1979	216822	3.64	219249	78.8	52.6	216822	0	0	1 mi.
Jul 1979	216822	3.65	219249	82.8	57.2	216822	0	0	1 mi.
Aug 1979	216822	7.97	216822	78.3	61.0	216822	0	0	1 mi.
Sep 1979	216822	.95	219249	75.1	48.2	216822	0	0	1 mi.
Oct 1979	216822	2.72	219249	59.6	34.3	216822	0	0	1 mi.
Nov 1979	216822	1.85	219249	41.4	24.0	216822	1.0	.1	1 mi.
Dec 1979	216822	.61	219249	35.7	16.3	216822	2.0	.1	1 mi.
Jan 1980	216822	1.32	219249	23.6	5.8	216822	9.8	3.5	1 mi.
Feb 1980	216822	.66	219249	25.7	2.6	216822	6.5	7.1	1 mi.
Mar 1980	216822	.76	219249	37.0	14.8	216822	8.6	4.5	1 mi.
Apr 1980	216822	1.18	219249	61.0	32.9	216822	7.0	.9	1 mi.
May 1980	216822	2.83	219249	76.3	44.0	216822	0	0	1 mi.
Jun 1980	216822	3.67	219249	80.7	53.9	216822	0	0	1 mi.
Jul 1980	216822	1.10	216822	87.4	63.7	216822	0	0	1 mi.
Aug 1980	216822	7.78	219249	81.7	58.2	216822	0	0	1 mi.
Sep 1980	216822	6.47	219249	73.7	47.9	216822	0	0	1 mi.
Oct 1980	216822	.92	472556	55.3	33.3	216822	0	0	1 mi.
Nov 1980	216822	.11	472556	46.2	25.4	216822	.5	0	1 mi.
Dec 1980	216822	.27	472556	28.1	9.9	216822	6.0	1.2	1 mi.
Jan 1981	216822	.10	472556	30.1	6.2	216822	2.3	.7	1 mi.
Feb 1981	216822	2.62	472556	32.8	12.1	216822	14.1	3.8	1 mi.
Mar 1981	216822	.53	472556	47.8	22.9	216822	.8	0	1 mi.
Apr 1981	216822	2.80	472556	61.0	36.9	216822	0	0	1 mi.
May 1981	216822	2.82	472556	68.7	42.3	216822	0	0	1 mi.
Jun 1981	216822	5.41	472556	78.0	53.0	216822	0	0	1 mi.
Jul 1981	216822	3.02	216822	82.4	64.2	216822	0	0	1 mi.
Aug 1981	216822	5.67	472556	79.3	57.0	216822	0	0	1 mi.
Sep 1981	216822	1.28	472556	71.5	44.9	216822	0	0	1 mi.
Oct 1981	216822	2.99	472556	56.7	33.1	216822	.8	0	1 mi.
Nov 1981	216822	.62	472556	46.2	24.8	216822	1.5	.3	1 mi.
Dec 1981	216822	.81	472556	25.7	7.2	216822	10.5	3.6	1 mi.
Jan 1982	216822	1.71	472556	14.3	-10.9	216822	36.0	14.0	1 mi.
Feb 1982	216822	.18	472556	26.0	2.2	216822	5.0	16.7	1 mi.
Mar 1982	216822	1.36	472556	36.8	16.7	216822	3.0	10.8	1 mi.
Apr 1982	216822	2.00	472556	54.1	27.2	216822	1.5	.1	1 mi.
May 1982	216822	5.43	472556	73.0	46.6	216822	0	0	1 mi.
Jun 1982	216822	2.05	472556	74.9	45.3	216822	0	0	1 mi.
Jul 1982	216822	4.98	472556	84.9	56.7	216822	0	0	1 mi.
Aug 1982	216822	3.28	472556	80.4	52.5	216822	0	0	1 mi.
Sep 1982	216822	5.04	472556	69.6	47.3	216822	0	0	1 mi.
Oct 1982	216822	3.75	472556	60.3	38.1	216822	0	0	1 mi.
Nov 1982	216822	2.99	472556	39.1	22.0	216822	2.5	.4	1 mi.
Dec 1982	216822	2.53	472556	33.2	17.0	216817	11.5	1.0	1 mi.
Jan 1983	216822	.75	472556	27.8	10.2	216822	3.3	3.8	1 mi.
Feb 1983	216822	.64	472556	33.0	17.4	216822	8.3	9.4	1 mi.
Mar 1983	216822	2.02	472556	41.2	23.8	216822	10.0	2.2	1 mi.
Apr 1983	216822	3.33	472556	52.0	29.0	216822	18.0	.9	1 mi.
May 1983	216822	3.86	472556	65.4	40.2	216822	0	0	1 mi.

Jun 1983	216822	2.35	472556	79.0	53.5	216822	0	0	1 mi.
Jul 1983	216822	5.04	472556	85.6	60.8	216822	0	0	1 mi.
Aug 1983	216822	2.59	472556	85.4	59.9	216822	0	0	1 mi.
Sep 1983	216822	4.04	472556	72.4	47.9	216822	0	0	1 mi.
Oct 1983	216822	1.78	472556	58.9	35.2	216822	0	0	1 mi.
Nov 1983	216822	3.41	472556	39.7	24.8	216822	20.0	2.2	1 mi.
Dec 1983	216822	.98	472556	13.7	-8.4	216822	17.0	16.7	1 mi.
Jan 1984	216822	.63	472556	22.3	-1.6	216822	11.0	16.1	1 mi.
Feb 1984	216822	1.10	472556	36.9	15.8	216822	0	8.6	1 mi.
Mar 1984	216822	2.28	472556	34.7	12.3	216822	17.0	4.1	1 mi.
Apr 1984	216822	3.94	472556	56.3	32.1	216822	2.0	.1	1 mi.
May 1984	216822	2.94	472556	67.8	39.0	216822	0	0	1 mi.
Jun 1984	216822	2.69	472556	79.9	54.7	216822	0	0	1 mi.
Jul 1984	216822	4.78	472556	82.3	53.5	216822	0	0	1 mi.
Aug 1984	216822	2.49	472556	83.7	55.3	216822	0	0	1 mi.
Sep 1984	216822	2.12	472556	70.8	39.1	216822	0	0	1 mi.
Oct 1984	216822	4.40	472556	61.4	34.8	216822	0	0	1 mi.
Nov 1984	216822	2.09	472556	43.0	18.7	216822	0	0	1 mi.
Dec 1984	216822	1.66	472556	28.6	7.9	216822	13.0	2.7	1 mi.
Jan 1985	216822	.35	472556	22.0	.3	216822	.3	3.1	1 mi.
Feb 1985	216822	.36	472556	25.5	4.4	216822	5.5	7.9	1 mi.
Mar 1985	216822	2.15	472556	46.6	24.8	216822	16.5	2.3	1 mi.
Apr 1985	216822	2.33	472556	64.4	37.0	216822	3.0	.2	1 mi.
May 1985	216822	3.90	472556	75.1	47.5	216822	0	0	1 mi.
Jun 1985	216822	1.53	472556	75.9	49.2	216822	0	0	1 mi.
Jul 1985	216822	1.87	472556	83.8	54.3	216822	0	0	1 mi.
Aug 1985	216822	5.22	472556	76.6	51.5	216822	0	0	1 mi.
Sep 1985	216822	5.54	472556	70.1	43.6	216822	0	0	1 mi.
Oct 1985	216822	2.70	472556	58.9	33.4	216822	0	0	1 mi.
Nov 1985	216822	1.20	472556	33.6	15.4	216822	13.5	1.9	1 mi.
Dec 1985	216822	1.26	472556	18.5	-4.2	216822	23.5	11.4	1 mi.
Jan 1986	216822	.72	472556	26.3	5.6	216822	7.8	9.8	1 mi.
Feb 1986	216822	.82	472556	25.4	4.0	216822	14.0	17.6	1 mi.
Mar 1986	216822	1.70	472556	44.5	21.6	216822	0	9.7	1 mi.
Apr 1986	216822	5.02	472556	62.4	36.9	216822	0	0	1 mi.
May 1986	216822	3.04	472556	71.5	45.7	216822	0	0	1 mi.
Jun 1986	216822	4.95	472556	80.0	53.6	216822	0	0	1 mi.
Jul 1986	216822	7.92	472556	82.7	59.8	216822	0	0	1 mi.
Aug 1986	216822	4.67	472556	77.8	52.4	216822	0	0	1 mi.
Sep 1986	216822	9.13	472556	70.6	48.2	216822	0	0	1 mi.
Oct 1986	216822	1.94	472556	60.2	35.6	216822	0	0	1 mi.
Nov 1986	216817	1.10	472556	38.0	17.1	216817	8.0	1.8	7 mi.
Dec 1986	216822	0	472556	31.1	12.7	216822	0	1.7	1 mi.
Jan 1987	216822	.40	472556	30.7	8.6	216822	6.0	1.0	1 mi.
Feb 1987	216822	0	472556	41.8	16.5	216822	.2	1.5	1 mi.
Mar 1987	216822	1.15	472556	49.5	23.7	216822	1.0	.2	1 mi.
Apr 1987	216822	.37	472556	68.4	31.8	216822	0	0	1 mi.
May 1987	216822	2.58	472556	73.3	46.2	216822	0	0	1 mi.
Jun 1987	216822	1.70	472556	83.8	53.8	216822	0	0	1 mi.
Jul 1987	216822	10.87	472556	83.5	60.5	216822	0	0	1 mi.
Aug 1987	216822	4.66	472556	74.4	53.5	216822	0	0	1 mi.
Sep 1987	216822	.67	472556	74.0	45.2	216822	0	0	1 mi.
Oct 1987	216822	1.85	472556	55.2	27.9	216822	2.5	0	1 mi.
Nov 1987	216822	1.92	472556	47.0	24.8	216822	.5	0	1 mi.
Dec 1987	216822	1.27	472556	31.8	14.2	216822	7.5	1.5	1 mi.
Jan 1988	216822	1.07	472556	17.7	-5.2	216822	14.0	7.6	1 mi.
Feb 1988	216822	.19	472556	22.5	-1.1	216822	6.8	10.3	1 mi.
Mar 1988	216822	1.17	472556	45.0	20.8	216822	2.0	.2	1 mi.
Apr 1988	216822	1.64	472556	61.4	32.7	216822	0	0	1 mi.
May 1988	216822	3.60	472556	77.9	48.9	216822	0	0	1 mi.

Jun 1988	216822	.63	472556	87.6	58.3	216822	0	0	1 mi.
Jul 1988	216822	1.18	472556	90.5	60.7	216822	0	0	1 mi.
Aug 1988	216822	3.70	219249	87.4	61.8	216822	0	0	1 mi.
Sep 1988	216822	4.82	472556	74.5	49.1	216822	0	0	1 mi.
Oct 1988	216822	.73	472556	57.1	31.7	216822	0	0	1 mi.
Nov 1988	216822	2.74	472556	42.4	25.8	216822	1.1	.1	1 mi.
Dec 1988	216822	.87	219249	31.8	10.3	216822	4.0	1.0	1 mi.
Jan 1989	216822	.36	219249	34.1	12.8	216822	2.5	3.1	1 mi.
Feb 1989	216822	.46	472556	22.5	-2.5	216822	7.0	6.4	1 mi.
Mar 1989	216822	2.77	472556	36.9	15.2	216822	17.5	6.2	1 mi.
Apr 1989	216822	2.23	472556	58.1	32.5	216822	0	0	1 mi.
May 1989	216822	3.59	472556	70.3	43.5	216822	0	0	1 mi.
Jun 1989	216822	3.05	472556	77.5	53.2	216822	0	0	1 mi.
Jul 1989	216822	2.29	472556	86.1	61.8	216822	0	0	1 mi.
Aug 1989	216822	3.35	472556	81.7	57.7	216822	0	0	1 mi.
Sep 1989	216822	1.37	216822	74.4	49.7	216822	0	0	1 mi.
Oct 1989	216822	.54	216822	64.7	38.1	216822	0	0	1 mi.
Nov 1989	216822	1.85	216822	39.5	21.3	216822	4.5	0	1 mi.
Dec 1989	216822	.22	216822	21.1	1.6	216822	2.5	.9	1 mi.
Jan 1990	216822	.44	216822	36.7	16.6	216822	7.0	2.0	1 mi.
Feb 1990	216822	.58	216822	34.3	11.4	216822	8.1	3.6	1 mi.
Mar 1990	216822	3.51	216822	47.0	26.7	216822	1.0	.1	1 mi.
Apr 1990	216822	5.35	216822	59.5	36.8	216822	0	0	1 mi.
May 1990	216822	4.51	216822	67.1	45.2	216822	0	0	1 mi.
Jun 1990	216822	8.07	216822	80.1	60.7	216822	0	0	1 mi.
Jul 1990	216822	3.88	216822	82.9	63.1	216822	0	0	1 mi.
Aug 1990	216822	1.27	216822	81.5	61.6	216822	0	0	1 mi.
Sep 1990	216822	1.31	216822	75.4	54.9	216822	0	0	1 mi.
Oct 1990	216817	1.96	472556	61.5	34.8	216817	0	0	7 mi.
Nov 1990	216822	.21	216822	49.4	29.3	216822	0	0	1 mi.
Dec 1990	216822	.91	216822	28.9	9.9	216822	m	4.2	1 mi.
Jan 1991	216822	.25	216822	23.1	4.7	216822	3.0	4.6	1 mi.
Feb 1991	216822	.60	216822	35.9	15.2	216822	6.0	4.0	1 mi.
Mar 1991	216822	3.10	216822	44.4	25.1	216822	4.5	1.8	1 mi.
Apr 1991	216822	2.93	216822	60.8	40.0	216822	0	0	1 mi.
May 1991	216822	5.10	216822	69.6	54.7	216822	0	0	1 mi.
Jun 1991	216817	3.21	472556	82.9	59.8	216817	0	0	7 mi.
Jul 1991	216822	4.14	216822	81.2	62.4	216822	0	0	1 mi.
Aug 1991	216822	3.02	216822	81.5	60.8	216822	0	0	1 mi.
Sep 1991	216822	4.54	216822	68.4	48.8	216822	0	0	1 mi.
Oct 1991	216822	1.14	216822	56.8	36.0	216822	0	0	1 mi.
Nov 1991	216822	4.21	216822	31.3	15.8	216817	28.9	6.2	1 mi.
Dec 1991	216822	1.21	216822	28.7	12.2	216822	9.0	4.9	1 mi.
Jan 1992	216822	.77	216822	28.6	13.9	216817	4.9	4.0	1 mi.
Feb 1992	216822	.60	216822	33.3	21.0	216822	3.6	3.1	1 mi.
Mar 1992	216822	1.53	216822	39.7	22.8	216817	14.0	1.2	1 mi.
Apr 1992	216822	2.46	216822	49.7	34.4	216822	0	0	1 mi.
May 1992	216822	.70	216822	72.0	47.1	216822	0	0	1 mi.
Jun 1992	216822	2.87	216822	75.4	52.6	216822	0	0	1 mi.
Jul 1992	216822	3.19	216822	74.5	55.6	216822	0	0	1 mi.
Aug 1992	216822	2.60	216822	76.1	53.9	216822	0	0	1 mi.
Sep 1992	216822	9.37	216822	69.9	47.6	216822	0	0	1 mi.
Oct 1992	216822	3.33	216822	57.6	36.0	216822	0	0	1 mi.
Nov 1992	216822	2.56	216822	36.4	26.8	216822	m	0	1 mi.
Dec 1992	216822	1.37	216822	28.5	13.3	216817	13.5	1.8	1 mi.
Jan 1993	216822	.77	216822	22.5	1.2	216817	17.0	9.5	1 mi.
Feb 1993	216822	.30	216822	24.1	6.7	216822	5.1	11.1	1 mi.
Mar 1993	216817	1.35	472556	38.0	18.0	216817	5.6	3.9	7 mi.
Apr 1993	216822	3.99	216822	51.6	33.7	216822	6.0	.2	1 mi.
May 1993	216822	5.85	216822	65.5	48.7	216822	0	0	1 mi.

Jun 1993	216822	6.68	216822	72.9	55.0	216822	0	0	1 mi.
Jul 1993	216822	5.40	216822	77.3	62.8	216822	0	0	1 mi.
Aug 1993	216822	5.60	216822	79.1	62.4	216822	0	0	1 mi.
Sep 1993	216822	1.67	216822	63.5	46.3	216822	0	0	1 mi.
Oct 1993	216822	.64	216822	57.0	36.0	216822	0	0	1 mi.
Nov 1993	216822	1.53	216822	37.8	24.2	216822	5.5	.7	1 mi.
Dec 1993	216822	.56	216822	27.9	14.8	216822	3.8	1.9	1 mi.
Jan 1994	216822	.76	216822	13.9	-6.3	216822	22.7	8.2	1 mi.
Feb 1994	216822	.31	216822	20.5	.2	216822	8.5	8.5	1 mi.
Mar 1994	216822	.23	216822	42.1	24.1	216822	0	.6	1 mi.
Apr 1994	216822	3.13	216822	55.5	34.9	216822	0	0	1 mi.
May 1994	216822	2.26	216822	70.5	47.7	216822	0	0	1 mi.
Jun 1994	216822	4.79	216822	79.6	58.5	216822	0	0	1 mi.
Jul 1994	216822	4.05	216822	78.3	59.0	216822	0	0	1 mi.
Aug 1994	216822	7.32	216822	76.8	57.1	216822	0	0	1 mi.
Sep 1994	216822	8.74	216822	72.5	54.5	216822	0	0	1 mi.
Oct 1994	216822	3.02	216822	60.1	43.9	216822	0	0	1 mi.
Nov 1994	216822	1.23	216822	45.1	29.8	216822	m	.2	1 mi.
Dec 1994	216822	.47	216822	31.9	16.4	216822	5.5	3.3	1 mi.
Jan 1995	216822	.37	216822	23.2	8.1	216822	4.1	2.5	1 mi.
Feb 1995	216822	.22	216822	28.0	8.0	216822	2.0	2.4	1 mi.
Mar 1995	216822	2.36	216822	40.8	24.2	216822	5.0	1.5	1 mi.
Apr 1995	216822	2.29	216822	49.4	32.5	216822	.3	0	1 mi.
May 1995	216822	2.54	216822	65.5	46.9	216822	0	0	1 mi.
Jun 1995	216822	2.11	216822	81.0	60.4	216822	0	0	1 mi.
Jul 1995	216822	2.07	216822	82.2	61.6	216822	0	0	1 mi.
Aug 1995	216822	3.48	216822	83.2	65.0	216822	0	0	1 mi.
Sep 1995	216822	1.82	216822	69.5	48.0	216822	0	0	1 mi.
Oct 1995	216822	5.32	216822	57.0	39.7	216822	m	0	1 mi.
Nov 1995	216822	1.08	216822	32.5	20.3	216822	6.8	.3	1 mi.
Dec 1995	216822	.83	216822	25.4	9.5	216822	12.1	3.7	1 mi.
Jan 1996	216822	1.82	216822	19.7	-2.4	216817	15.0	8.8	1 mi.
Feb 1996	216822	.10	216822	25.2	5.8	216822	.5	9.5	1 mi.
Mar 1996	216822	1.75	216822	32.7	13.2	216822	12.2	5.2	1 mi.
Apr 1996	216822	.67	216822	50.5	30.7	216822	0	.1	1 mi.
May 1996	216822	2.46	216822	63.0	46.8	216822	0	0	1 mi.
Jun 1996	216822	4.44	216822	77.0	57.8	216822	0	0	1 mi.
Jul 1996	216822	1.46	216822	79.4	59.2	216822	0	0	1 mi.
Aug 1996	216822	2.92	216822	80.5	58.1	216822	0	0	1 mi.
Sep 1996	216817	2.86	472556	70.3	49.2	216817	0	0	7 mi.
Oct 1996	216822	3.48	216822	59.5	38.2	216822	0	0	1 mi.
Nov 1996	216822	3.51	216822	32.2	18.3	216822	12.1	2.6	1 mi.
Dec 1996	216822	1.09	216822	21.7	7.8	216817	19.3	7.7	1 mi.
Jan 1997	216822	.79	216822	19.4	.3	216817	17.5	12.0	1 mi.
Feb 1997	216822	.44	216822	28.9	9.4	216817	5.8	14.0	1 mi.
Mar 1997	216822	1.02	216822	37.1	20.5	216822	5.0	3.7	1 mi.
Apr 1997	216822	.65	216822	53.1	32.9	216822	0	0	1 mi.
May 1997	216822	2.51	216822	62.4	42.7	216822	0	0	1 mi.
Jun 1997	216822	3.07	216822	80.3	57.4	216822	0	0	1 mi.
Jul 1997	216822	10.48	216822	79.3	60.8	216822	0	0	1 mi.
Aug 1997	216822	4.25	216822	76.5	58.9	216822	0	0	1 mi.
Sep 1997	216822	3.43	216822	72.1	53.2	216822	0	0	1 mi.
Oct 1997	216822	1.58	216822	59.6	38.7	216822	0	0	1 mi.
Nov 1997	216822	.62	216822	35.4	21.7	216822	3.5	.1	1 mi.
Dec 1997	216822	.14	216822	33.2	19.9	216822	3.0	.2	1 mi.
Jan 1998	216822	1.11	216822	25.0	12.7	216817	21.0	8.0	1 mi.
Feb 1998	216822	1.27	216822	37.4	24.8	216822	.3	3.9	1 mi.
Mar 1998	216822	4.23	216822	38.8	23.5	216822	3.0	.3	1 mi.
Apr 1998	216822	4.13	216822	60.6	40.8	216822	0	0	1 mi.
May 1998	216822	5.28	216822	76.3	52.7	216822	0	0	1 mi.

Jun 1998	216822	7.41	216822	74.4	55.1	216822	0	0	1 mi.
Jul 1998	216817	1.16	472556	81.7	60.0	216817	0	0	7 mi.
Aug 1998	216822	5.35	216822	81.1	61.6	216822	0	0	1 mi.
Sep 1998	216822	2.82	216822	78.9	52.8	216822	0	0	1 mi.
Oct 1998	216822	2.25	216822	60.7	40.9	216822	0	0	1 mi.
Nov 1998	216822	1.16	216822	44.6	29.0	216822	0	0	1 mi.
Dec 1998	216822	.24	216822	35.3	16.4	216822	1.0	.4	1 mi.
Jan 1999	216817	1.73	216822	19.2	2.1	216817	28.3	8.1	7 mi.
Feb 1999	216822	.74	216822	35.0	17.6	216822	4.0	4.4	1 mi.
Mar 1999	216822	1.42	216822	43.0	20.7	216822	16.0	3.5	1 mi.
Apr 1999	216822	4.70	216822	57.4	40.2	216822	0	0	1 mi.
May 1999	216822	5.42	216822	69.9	51.2	216822	0	0	1 mi.
Jun 1999	216822	3.45	216822	75.9	57.7	216822	0	0	1 mi.
Jul 1999	216822	3.86	216822	84.9	64.1	216822	0	0	1 mi.
Aug 1999	216822	3.60	216822	78.6	59.6	216822	0	0	1 mi.
Sep 1999	216822	1.36	216822	71.5	48.5	216822	0	0	1 mi.
Oct 1999	216822	1.20	216822	58.9	35.1	216822	0	0	1 mi.
Nov 1999	216822	1.33	216822	51.4	30.2	216822	0	0	1 mi.
Dec 1999	216822	.36	216822	32.8	15.6	216822	2.5	1.3	1 mi.
Jan 2000	216822	.72	216822	24.3	3.8	216822	8.8	6.5	1 mi.
Feb 2000	216822	1.18	216822	34.8	16.1	216822	5.0	7.1	1 mi.
Mar 2000	216822	.85	216822	49.8	28.8	216822	0	0	1 mi.
Apr 2000	216822	1.57	216822	56.8	34.5	216822	0	0	1 mi.
May 2000	216822	3.22	216822	69.8	48.4	216822	0	0	1 mi.
Jun 2000	216822	7.98	216822	75.9	54.8	216822	0	0	1 mi.
Jul 2000	216822	4.11	216822	80.8	62.5	216822	0	0	1 mi.
Aug 2000	216822	3.75	216822	80.8	61.0	216822	0	0	1 mi.
Sep 2000	216822	1.92	216822	72.1	49.1	216822	0	0	1 mi.
Oct 2000	216822	.62	216822	63.3	41.8	216822	0	0	1 mi.
Nov 2000	216822	4.64	216822	38.5	25.3	216822	4.5	1.4	1 mi.
Dec 2000	216822	1.02	216822	14.7	.3	216822	22.3	6.2	1 mi.
Jan 2001	216822	1.11	216822	27.3	8.2	216822	8.5	8.2	1 mi.
Feb 2001	216822	1.23	216822	21.6	-.7	216822	10.6	11.0	1 mi.
Mar 2001	216822	.73	216822	35.5	17.2	216822	6.0	10.9	1 mi.
Apr 2001	216822	5.13	216822	56.9	37.7	216822	0	.3	1 mi.
May 2001	216822	3.71	216822	68.0	50.1	216822	0	0	1 mi.
Jun 2001	216822	5.20	216822	77.4	58.1	216822	0	0	1 mi.
Jul 2001	216822	2.50	216822	84.0	62.1	216822	0	0	1 mi.
Aug 2001	216822	2.90	216822	82.6	61.3	216822	0	0	1 mi.
Sep 2001	216822	2.40	216822	69.3	49.4	216817	0	0	1 mi.
Oct 2001	216822	1.46	216822	58.2	37.1	216822	0	0	1 mi.
Nov 2001	216822	2.10	216822	55.4	34.9	216822	0	0	1 mi.
Dec 2001	216822	.18	216822	35.9	20.8	216822	m	.3	1 mi.
Jan 2002	216822	.62	216822	31.5	15.5	216822	4.4	2.2	1 mi.
Feb 2002	216822	.49	216822	35.8	15.6	216822	4.8	1.0	1 mi.
Mar 2002	216822	2.00	216822	32.4	16.1	216822	7.1	1.7	1 mi.
Apr 2002	216822	3.42	216822	54.4	35.3	216822	8.0	.7	1 mi.
May 2002	216822	2.69	216822	65.0	43.3	216822	0	0	1 mi.
Jun 2002	216822	10.28	216822	79.3	59.1	216822	0	0	1 mi.
Jul 2002	216822	4.30	216822	86.3	65.6	216822	0	0	1 mi.
Aug 2002	216822	7.61	216822	79.5	60.8	216822	0	0	1 mi.
Sep 2002	216822	4.78	216822	74.2	55.4	216822	0	0	1 mi.
Oct 2002	216822	4.64	216822	50.5	35.8	216822	0	0	1 mi.
Nov 2002	216822	.05	216822	39.2	24.4	216822	0	0	1 mi.
Dec 2002	216822	.17	216822	32.7	17.3	216822	2.3	.2	1 mi.
Jan 2003	216817	.90	216822	22.6	6.2	216822	2.9	.4	7 mi.
Feb 2003	216822	.54	216822	25.6	4.0	216822	5.8	2.4	1 mi.
Mar 2003	216822	1.34	216822	40.1	21.5	216817	9.5	1.0	1 mi.
Apr 2003	216822	3.14	216822	57.8	35.0	216822	0	0	1 mi.
May 2003	216822	5.01	216822	67.3	47.5	216822	0	0	1 mi.

Jun 2003	216822	2.33	216822	77.2	56.6	216822	0	0	1 mi.
Jul 2003	216822	1.87	216822	82.3	62.8	216822	0	0	1 mi.
Aug 2003	216822	.84	216822	83.9	61.1	216822	0	0	1 mi.
Sep 2003	216822	1.60	216822	73.3	49.6	216822	0	0	1 mi.
Oct 2003	216822	.67	216822	60.7	38.5	216822	0	0	1 mi.
Nov 2003	216822	1.21	216822	39.6	25.4	216822	0	0	1 mi.
Dec 2003	216822	.59	216822	32.0	17.2	216822	6.6	3.5	1 mi.
Jan 2004	216822	.38	216822	19.9	4.2	216817	5.8	1.3	1 mi.
Feb 2004	216822	1.52	216822	28.2	10.5	216822	18.5	9.4	1 mi.
Mar 2004	216822	4.06	216822	43.6	26.6	216822	5.8	1.9	1 mi.
Apr 2004	216822	2.05	216822	60.1	35.2	216822	0	0	1 mi.
May 2004	216822	6.23	216822	66.0	44.3	216822	0	0	1 mi.
Jun 2004	216822	4.88	216822	73.8	56.3	216822	0	0	1 mi.
Jul 2004	216822	3.62	216822	80.6	60.4	216822	0	0	1 mi.
Aug 2004	216822	2.58	216822	74.7	54.4	216822	0	0	1 mi.
Sep 2004	216822	4.66	216822	77.2	55.1	216822	0	0	1 mi.
Oct 2004	216822	2.14	216822	59.3	40.4	216822	0	0	1 mi.
Nov 2004	216822	m	216822	m	m	216822	0	0	1 mi.
Dec 2004	216822	.43	216822	30.5	14.7	216822	.3	0	1 mi.
Jan 2005	216822	.86	216822	22.4	6.8	216822	7.8	3.2	1 mi.
Feb 2005	216822	1.20	216822	33.5	16.9	216822	11.8	3.0	1 mi.
Mar 2005	216822	1.96	216822	39.1	19.1	216822	8.3	2.3	1 mi.
Apr 2005	216822	1.46	216822	61.0	40.3	216822	0	0	1 mi.
May 2005	216822	3.81	216822	63.7	45.7	216822	0	0	1 mi.
Jun 2005	216822	m	216822	m	m	213567	0	0	1 mi.
Jul 2005	216822	1.83	216822	84.8	63.3	216822	0	0	1 mi.
Aug 2005	216822	m	216822	m	m	213567	0	0	1 mi.
Sep 2005	216822	6.04	216822	76.0	53.8	216822	0	0	1 mi.
Oct 2005	216822	1.13	216822	62.4	41.8	216822	0	0	1 mi.
Nov 2005	216822	1.57	216822	44.8	27.4	216822	2.2	.1	1 mi.
Dec 2005	216822	1.00	216822	23.9	12.5	216822	16.0	4.0	1 mi.
Jan 2006	216822	.98	216822	34.6	21.4	216822	5.5	1.9	1 mi.
Feb 2006	216822	.27	216822	28.6	10.7	216822	1.0	.7	1 mi.
Mar 2006	216822	.72	216822	40.5	22.2	216822	11.0	5.9	1 mi.
Apr 2006	216822	2.44	216822	62.1	41.2	216822	0	0	1 mi.
May 2006	216822	3.14	216822	68.8	50.4	216822	0	0	1 mi.
Jun 2006	216822	1.20	216822	79.8	57.3	216822	0	0	1 mi.
Jul 2006	216822	1.69	216822	87.3	64.1	216822	0	0	1 mi.
Aug 2006	216822	6.76	216822	80.7	61.2	216822	0	0	1 mi.
Sep 2006	216822	3.26	216822	67.9	49.3	216822	0	0	1 mi.
Oct 2006	216822	1.52	216822	55.6	34.8	216822	0	0	1 mi.
Nov 2006	216822	1.39	216822	44.2	27.1	216822	4.0	.4	1 mi.
Dec 2006	216822	1.59	216822	34.8	21.1	216822	0	0	1 mi.
Jan 2007	216822	1.29	216822	27.5	12.1	216822	1.0	1.7	1 mi.
Feb 2007	216822	1.20	216822	20.0	2.2	216822	11.2	3.3	1 mi.
Mar 2007	216822	2.75	216822	45.2	26.5	216822	14.0	4.4	1 mi.
Apr 2007	216822	1.56	216822	55.7	36.2	216822	0	0	1 mi.
May 2007	216822	4.00	216822	74.3	49.9	216822	0	0	1 mi.
Jun 2007	216822	2.71	216822	81.4	59.7	216822	0	0	1 mi.
Jul 2007	216822	.90	216822	84.6	60.9	216822	0	0	1 mi.
Aug 2007	216822	10.37	216822	80.1	61.0	216822	0	0	1 mi.
Sep 2007	216822	3.20	216822	75.7	51.7	216822	0	0	1 mi.
Oct 2007	216822	4.18	216822	63.4	46.2	216822	0	0	1 mi.
Nov 2007	216822	.20	216822	42.8	26.9	216822	0	0	1 mi.
Dec 2007	216822	1.29	216822	23.7	8.1	216822	17.0	5.2	1 mi.
Jan 2008	216822	.20	216822	21.2	3.1	216822	3.2	5.2	1 mi.
Feb 2008	216822	.30	216822	22.6	3.3	216822	6.9	7.3	1 mi.
Mar 2008	216822	.90	216822	36.7	16.8	m	m	1 mi.	
Apr 2008	216822	5.09	216822	52.3	34.2	m	m	1 mi.	
May 2008	216822	2.31	216822	65.8	44.9	m	m	1 mi.	

Jun 2008	216822	4.24	216822	76.9	58.1	m	m	1	mi.
Jul 2008	216822	2.56	216822	84.2	60.8	m	m	1	mi.
Aug 2008	216822	m	216822	m	m	m	m	1	mi.
Sep 2008	m	m	m	m	m	999	mi.		
Oct 2008	m	m	m	m	m	999	mi.		
Nov 2008	m	m	m	m	m	999	mi.		
Dec 2008	m	m	m	m	m	999	mi.		

Where indicated: Missing values are shown as 'm'. Days on which precip accumulated in the gage are shown as '-'. 'TTTT RR SS' is the 'public land survey(PLS)' or 'legal' location of the observed data. Section values greater 36 are SECTIC 'TIC' locations plus 100. 'NWS ID' the National Weather Service Cooperative station number. Note that the 'PLS' will always be correct for precipitation data while the 'NWS ID' will always be correct for the temperature data. If no PLS info is supplied the the 'NWS ID' number applies to all shown data.

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Minnesota and United States Climate Extremes

Climate Extremes for Minnesota

Temperature	Record	Date	Location	County
Maximum	114 degrees F.	July 29, 1917 July 6, 1936	Beardsley Moorhead	Big Stone Clay
Minimum	-60 degrees F.	February 2, 1996	near Tower	St. Louis
Maximum 24-hour change	71 degrees F.	April 3, 1982	Lamberton	Redwood
Snow				
Maximum 24-hour snowfall	36.0 inches	January 7, 1994	near Finland	Lake
Maximum single storm snowfall	46.5 inches	January 6-8, 1994	near Finland	Lake
Maximum seasonal snowfall	170.5 inches	1949-1950	near Grand Portage	Cook
Maximum snow cover	75 inches	March 28, 1950	near Grand Portage	Cook
Earliest measurable snowfall	0.3 inches	Sept. 14, 1964	International Falls	Koochiching
Latest measurable snowfall	1.5 inches	June 4, 1935	Mizpah	Koochiching
Rain				
Maximum 24-hour total	15.10 inches	August 19, 2007	Hokah	Houston
Maximum monthly total	23.86 inches	August 2007	Hokah	Houston
Maximum annual total	53.52 inches	1991	St. Francis	Anoka
Minimum annual total	6.37 inches	1976	Ortonville	Big Stone
Longest dry spell	79 days	11/9/43 - 1/26/44	Beardsley, Canby, Marshall, Dawson	
Wind				
Maximum measured gust	110 mph (tornado)	August 20, 1904	Minneapolis	Hennepin
Pressure				
Maximum	31.11 inches	January 21, 1922	Collegeville	Stearns
Minimum	28.43 inches	Nov. 10, 1998	Albert Lea, Austin	Cook

What was the coldest windchill ever seen in Minnesota? The answer can be a little tricky because on November 2001 the formula on how to calculate the windchill was changed. Perhaps the coldest windchill the Twin Cities has ever seen was -67 with the new formula (-87 with the old formula) back on January 22nd 1936. The temperature was -34 with a wind speed of 20 mph. Without a lengthy state-wide wind record, it is difficult to say when was the coldest statewide windchill. There are some candidate dates though besides January 22, 1936. On January 9th and 10th, 1982 temperatures of -30 and winds of around 40mph were

Wind Roses for Minnesota and surrounding cities

The wind rose shows how often the wind comes from a certain direction. The directions have been split up into sixteen sections of 22.5 degrees. The longer a bar, the more often the wind comes from the corresponding direction. The wind rose presents a scale which can be used to read the relative frequency. All bars for each month count up to 100%.

These wind roses were constructed for the MN/DOT Snow Climatology Project
Click on the city to see the wind rose plots.

Austin Municipal
Alexandria
Baudette
Bemidji
Benson Municipal
Big Fork Municipal
Brainerd
Brookings, SD
Cambridge
Cloquet-Carlton Co.
Cook Municipal
Crookston
Detroit Lakes
Dodge Center Airport
Duluth
Sky Harbor (Duluth)
Eau Claire, WI
Ely Municipal
Eveleth-Virginia Municipal
Fairmont
Fargo, ND
Faribault Municipal
Flag Island
Fosston
Glencoe Municipal Airport
Glenwood
Grand Forks, ND
Grand Marais (airport)
Grand Marais (shore)
Grand Rapids
Hallock
Hayward, WI
Hibbing
Hutchinson Municipal
International Falls
Jackson Municipal
La Crosse, WI
Litchfield Municipal
Little Falls-Morrison County
Longville Municipal
Madison-Lac Qui Parle
Mankato
Maple Lake Municipal Airport
Marshall
Minneapolis/Lakeville
Minneapolis/St. Paul Intl.
Montevideo-Chippewa
Mora Municipal
Morris Municipal
New Ulm Municipal
Orr Regional
Ortonville Municipal
Owatonna Municipal
Park Rapids
Princeton Municipal
Pine River
Pipestone Municipal
Red Wing
Redwood Falls
Rice Lake, WI
Rochester
Roseau Municipal
Rush City Municipal Airport
Scotts Field (Crane Lake)
Sky Harbor (Duluth)
Silver Bay
Sioux Falls, SD
Staples Municipal
South St. Paul
St. Cloud
St. James Municipal
St. Paul
Superior, WI
Thief River Falls
Two Harbors
Worthington
Warroad
Waskish Municipal
Watertown, SD
Wheaton
Willmar Municipal
Windom Municipal
Winona Municipal

Data prepared in conjunction with:

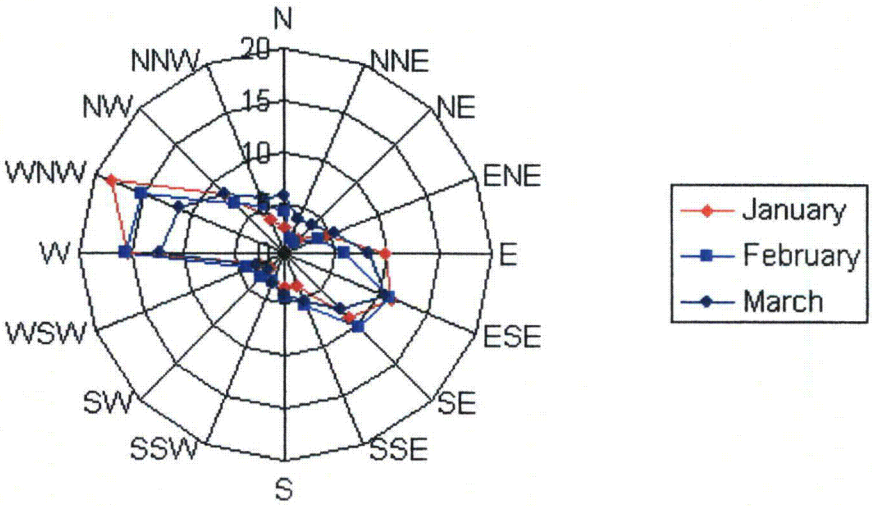
Climatological Characterization of Snowfall and Snow Drift in Minnesota (for the Design of Living Snow Fences) MN/DOT Agreement No. 74708

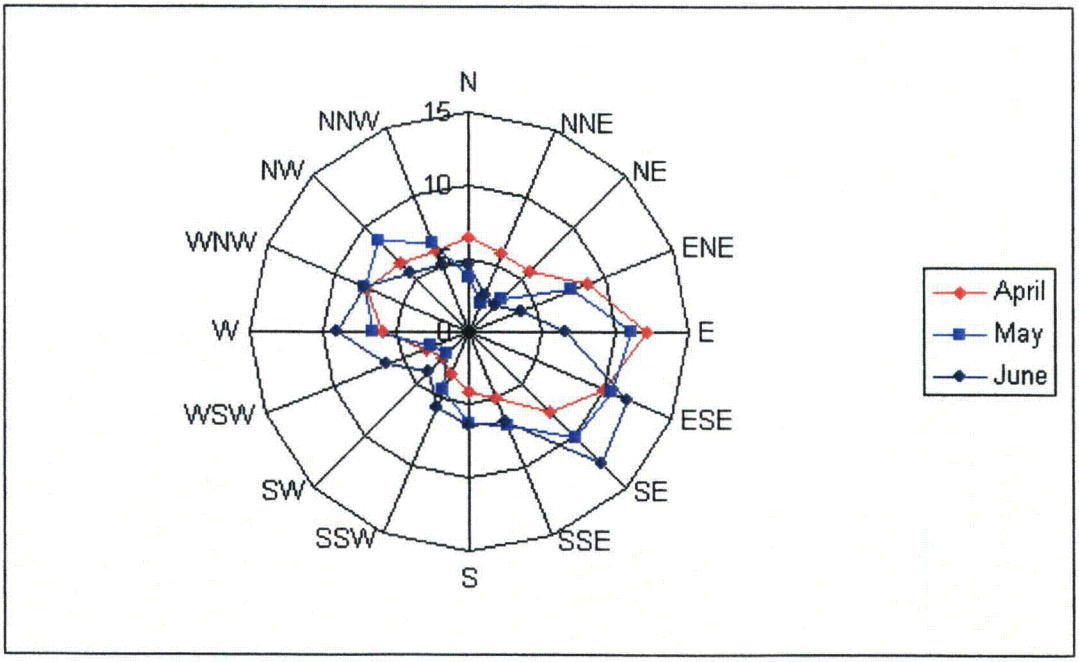
Comments/Questions

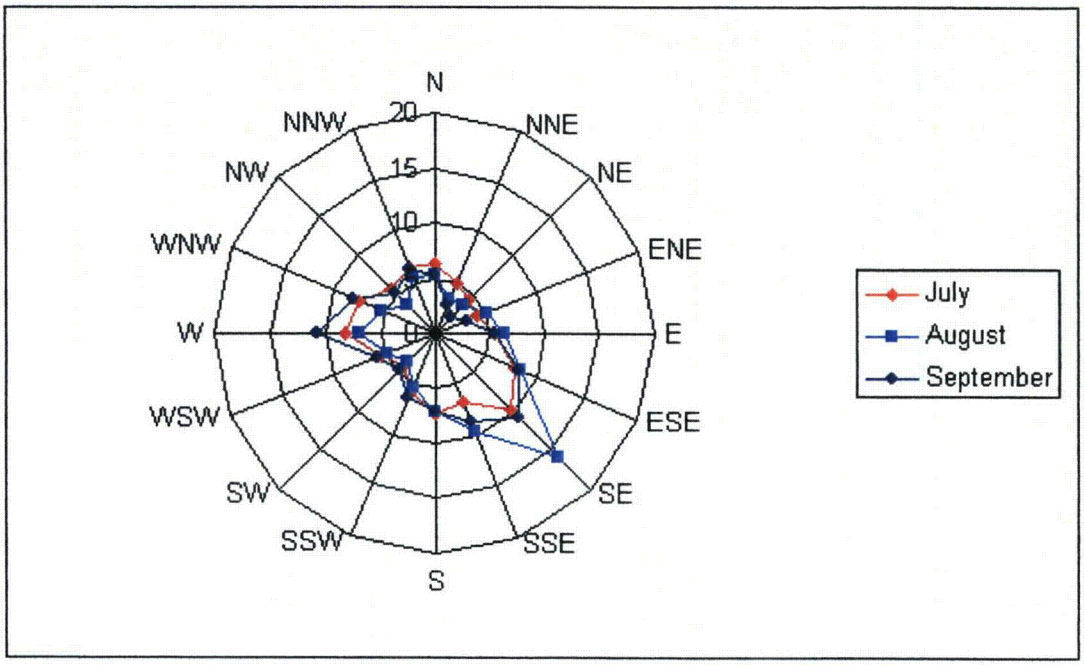
URL: http://climate.umn.edu/wind/windRoseClimatology.htm
Last modified: March 15, 2005

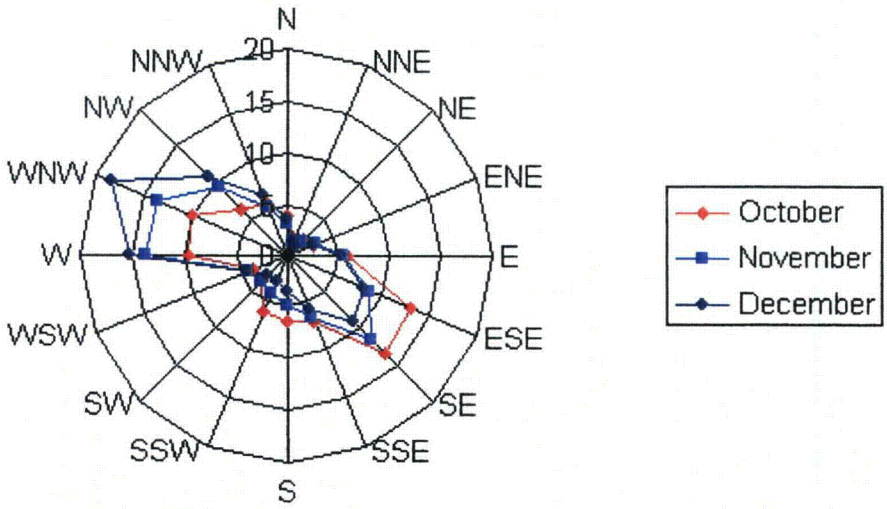
Wind Roses for Red Wing (KRGK)

This wind rose data is from all non-calm winds three times a hour from approximately October 1996 to March 2001. Note that the plots below are for wind direction only and not an indication of wind speed.









Special thanks to:

Mark Seeley, Martha Shulski, Kenny Blumenfeld and Amy Cecchi.

Return to Minnesota Climatology Working Group Main page

Comments/Questions

URL: http://climate.umn.edu/wind/krgk.htm
Last modified: October 6, 2004

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center
U.S. Department of Commerce

Query Results

373 event(s) were reported in **Dakota County, Minnesota** between **01/01/1950** and **05/31/2008 (High Wind limited to speed greater than 0 knots)**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Minnesota

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 DAKOTA	07/07/1957	2133	Tstm Wind	60 kts.	0	0	0	0
2 DAKOTA	08/04/1958	0200	Tstm Wind	0 kts.	0	0	0	0
3 DAKOTA	05/28/1959	1000	Tstm Wind	0 kts.	0	0	0	0
4 DAKOTA	05/23/1964	1806	Tstm Wind	92 kts.	0	0	0	0
5 DAKOTA	05/25/1964	1900	Hail	1.50 in.	0	0	0	0
6 DAKOTA	06/05/1965	1700	Tornado	F1	0	0	3K	0
7 DAKOTA	07/09/1966	0100	Hail	1.75	0	0	0	0

				in.				
8 DAKOTA	06/15/1967	0115	Tornado	F0	0	0	25K	0
9 DAKOTA	05/15/1968	1335	Hail	1.75 in.	0	0	0	0
10 DAKOTA	05/15/1968	1435	Tornado	F2	0	1	250K	0
11 DAKOTA	06/20/1968	1900	Tstm Wind	0 kts.	0	0	0	0
12 DAKOTA	06/20/1968	2010	Hail	2.00 in.	0	0	0	0
13 DAKOTA	06/20/1968	2100	Tstm Wind	0 kts.	0	0	0	0
14 DAKOTA	06/20/1968	2100	Tstm Wind	0 kts.	0	0	0	0
15 DAKOTA	07/23/1968	0400	Hail	1.25 in.	0	0	0	0
16 DAKOTA	07/13/1969	0629	Tornado	F1	0	3	25K	0
17 DAKOTA	07/13/1969	0730	Tstm Wind	0 kts.	0	0	0	0
18 DAKOTA	07/15/1969	1910	Tornado	F1	0	0	3K	0
19 DAKOTA	06/13/1970	1620	Tstm Wind	0 kts.	0	0	0	0
20 DAKOTA	07/14/1971	1822	Tornado	F0	0	0	25K	0
21 DAKOTA	09/29/1971	2140	Hail	1.00 in.	0	0	0	0
22 DAKOTA	05/09/1973	1337	Tornado	F1	1	11	250K	0
23 DAKOTA	04/20/1974	2040	Tstm Wind	0 kts.	0	0	0	0

24 DAKOTA	06/20/1974	1225	Hail	0.75 in.	0	0	0	0
25 DAKOTA	06/20/1974	1225	Tstm Wind	0 kts.	0	0	0	0
26 DAKOTA	06/20/1974	1225	Tstm Wind	0 kts.	0	0	0	0
27 DAKOTA	07/05/1975	0100	Hail	1.75 in.	0	0	0	0
28 DAKOTA	07/05/1975	0115	Hail	1.75 in.	0	0	0	0
29 DAKOTA	05/14/1977	2330	Tstm Wind	61 kts.	0	0	0	0
30 DAKOTA	06/28/1979	1940	Tornado	F0	0	0	25K	0
31 DAKOTA	06/07/1980	0130	Tstm Wind	0 kts.	0	0	0	0
32 DAKOTA	06/07/1980	0155	Tstm Wind	0 kts.	0	0	0	0
33 DAKOTA	07/15/1980	2110	Tstm Wind	90 kts.	0	0	0	0
34 DAKOTA	08/19/1980	2207	Tstm Wind	52 kts.	0	0	0	0
35 DAKOTA	08/19/1980	2315	Tstm Wind	70 kts.	0	0	0	0
36 DAKOTA	09/03/1980	2030	Tstm Wind	70 kts.	0	0	0	0
37 DAKOTA	04/29/1981	1455	Tornado	F1	0	0	250K	0
38 DAKOTA	06/14/1981	0523	Tstm Wind	61 kts.	0	0	0	0

39 DAKOTA	06/14/1981	0630	Tstm Wind	87 kts.	0	0	0	0
40 DAKOTA	06/14/1981	1725	Tstm Wind	0 kts.	0	0	0	0
41 DAKOTA	06/23/1981	1600	Tstm Wind	0 kts.	0	0	0	0
42 DAKOTA	05/04/1982	1650	Tstm Wind	0 kts.	0	0	0	0
43 DAKOTA	07/15/1982	1725	Tornado	F1	0	0	25K	0
44 DAKOTA	08/26/1982	1940	Tstm Wind	70 kts.	0	0	0	0
45 DAKOTA	07/19/1983	1545	Tstm Wind	0 kts.	0	0	0	0
46 DAKOTA	08/07/1984	0300	Hail	1.75 in.	0	0	0	0
47 DAKOTA	08/07/1984	0300	Tstm Wind	0 kts.	0	0	0	0
48 DAKOTA	04/12/1985	1615	Hail	0.75 in.	0	0	0	0
49 DAKOTA	05/14/1985	1721	Hail	1.00 in.	0	0	0	0
50 DAKOTA	05/14/1985	1722	Hail	1.00 in.	0	0	0	0
51 DAKOTA	03/31/1986	1715	Tstm Wind	0 kts.	0	0	0	0
52 DAKOTA	04/25/1986	1520	Hail	2.00 in.	0	0	0	0
53 DAKOTA	04/25/1986	1530	Hail	0.75	0	0	0	0

				in.				
54 DAKOTA	04/25/1986	1535	Hail	2.50 in.	0	0	0	0
55 DAKOTA	04/25/1986	1550	Hail	2.75 in.	0	0	0	0
56 DAKOTA	07/12/1986	1930	Tstm Wind	0 kts.	0	0	0	0
57 DAKOTA	07/27/1986	0400	Tstm Wind	0 kts.	0	0	0	0
58 DAKOTA	05/10/1987	1506	Hail	1.00 in.	0	0	0	0
59 DAKOTA	05/10/1987	1506	Hail	1.00 in.	0	0	0	0
60 DAKOTA	05/13/1987	1836	Hail	0.75 in.	0	0	0	0
61 DAKOTA	05/13/1987	1842	Tornado	F1	0	0	3K	0
62 DAKOTA	05/13/1987	1858	Tornado	F0	0	0	0K	0
63 DAKOTA	06/28/1987	1712	Tstm Wind	0 kts.	0	0	0	0
64 DAKOTA	07/20/1987	1745	Hail	1.75 in.	0	0	0	0
65 DAKOTA	07/20/1987	1815	Hail	1.75 in.	0	0	0	0
66 DAKOTA	07/27/1987	1433	Tornado	F1	0	0	250K	0
67 DAKOTA	07/27/1987	1620	Tstm Wind	0 kts.	0	0	0	0
68 DAKOTA	05/07/1988	1730	Hail	1.75 in.	0	0	0	0

69 DAKOTA	08/07/1988	1800	Tstm Wind	60 kts.	0	0	0	0
70 DAKOTA	05/23/1989	1725	Hail	2.75 in.	0	0	0	0
71 DAKOTA	05/29/1989	1355	Hail	0.75 in.	0	0	0	0
72 DAKOTA	08/26/1990	0340	Tstm Wind	0 kts.	0	0	0	0
73 DAKOTA	05/28/1991	2210	Hail	0.75 in.	0	0	0	0
74 DAKOTA	05/28/1991	2210	Tstm Wind	0 kts.	0	0	0	0
75 DAKOTA	05/30/1991	1523	Hail	1.00 in.	0	0	0	0
76 DAKOTA	07/01/1991	0025	Tstm Wind	0 kts.	0	0	0	0
77 DAKOTA	08/01/1992	2007	Hail	1.00 in.	0	0	0	0
78 DAKOTA	09/04/1992	0610	Hail	1.50 in.	0	0	0	0
79 W St. Paul	08/18/1993	0550	Thunderstorm Winds	0 kts.	0	0	0	0
80 Lakeville	08/27/1993	2330	Thunderstorm Winds	0 kts.	0	0	0	0
81 MNZ003 - 012 - 019>021 - 027 - 038 - 041>045 - 050>053 - 061>063 - 070 - 078 -	01/05/1994	1100	Heavy Snow	N/A	0	0	0	0
82 All Of Minnesota	01/15/1994	0100	Extreme Cold	N/A	1	0	0	0

83 Southern Mn	04/15/1994	0900	High Wind	0 kts.	0	0	0	0
84 MNZ011 - 012 - 018>021 - 025 - 026 - 032>038 - 040>096	04/28/1994	0400	Heavy Snow And Ice	N/A	0	0	0	0
85 Eagan	05/10/1994	2130	Lightning	N/A	0	0	500K	0
86 Bloomington	06/10/1994	1205	Hail	1.75 in.	0	0	0	0
87 Eagan	07/05/1994	0350	Thunderstorm Winds	65 kts.	0	0	500K	0
88 MNZ020 - 021 - 029>098	11/27/1994	0500	Heavy Snow/ice	N/A	0	0	0	0
89 Lakeville	06/23/1995	1515	Hail	0.75 in.	0	0	0	0
90 Rosemount	06/23/1995	1520	Hail	1.00 in.	0	0	0	0
91 South And Portions Of	07/10/1995	1300	Heat Wave	N/A	2	0	2.0M	0
92 Eagan	07/14/1995	1803	Hail	1.00 in.	0	0	0	0
93 Farmington	07/15/1995	1530	Funnel Clouds	N/A	0	0	0	0
94 Burnsville	08/06/1995	1800	Thunderstorm Winds	0 kts.	0	0	0	0
95 Minneapolis	09/30/1995	1525	Hail	0.75 in.	0	0	0	0
96 Eagan	09/30/1995	1540	Hail	1.75 in.	0	0	0	0

97 Portions Of Central M	11/26/1995	1500	Heavy Snow	N/A	0	0	0	0
98 Central And South Mn	12/08/1995	0300	Heavy Snow	N/A	0	0	0	0
99 Central And South Mn	12/08/1995	1400	Low Wind Chill	N/A	0	0	0	0
100 Central And South Mn	12/13/1995	0200	Glaze	N/A	0	0	0	0
101 MNZ058>063 - 065>070 - 074>079 - 083>086	01/10/1996	01:00 PM	Heavy Snow	N/A	0	0	0	0
102 MNZ060>063 - 067>070 - 075>076 - 082>083	01/17/1996	02:00 PM	Ice Storm	N/A	0	0	0	0
103 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	01/18/1996	06:00 PM	Extreme Windchill	N/A	0	0	0	0
104 MNZ041>045 - 047>070 - 073>079 - 082>088 - 091>096	01/31/1996	04:00 AM	Extreme Cold	N/A	0	0	0	0
105 MNZ041>045 - 047>070 - 073>079 - 082>088 - 091>096	02/01/1996	12:00 AM	Extreme Cold	N/A	0	0	0	0
106 MNZ042>045 - 049>054 - 056>070 - 073>079 - 082>087 - 091>093	03/23/1996	09:00 PM	Heavy Snow	N/A	0	0	0	0
107 Lakeville	05/19/1996	12:01 AM	Tstm Wind	70 kts.	0	0	4.5M	0
108 Farmington	05/19/1996	12:15 AM	Tstm Wind	55	0	0	25K	0

				kts.				
109 Farmington	06/29/1996	01:06 PM	Tstm Wind	60 kts.	0	0	0	0
110 Vermillion	06/29/1996	01:15 PM	Tstm Wind	65 kts.	0	0	0	0
111 Hastings	06/29/1996	01:25 PM	Tstm Wind	65 kts.	0	0	0	0
112 Hastings	06/29/1996	01:25 PM	Tstm Wind	70 kts.	0	0	0	0
113 Hastings	06/29/1996	01:28 PM	Hail	0.75 in.	0	0	0	0
114 Hastings	07/06/1996	03:45 PM	Tornado	F0	0	0	0	0
115 Apple Valley	08/06/1996	09:51 PM	Tstm Wind	54 kts.	0	0	0	0
116 Lilydale	08/06/1996	09:51 PM	Tstm Wind	52 kts.	0	0	0	0
117 Rosemount	08/06/1996	09:51 PM	Tstm Wind	55 kts.	0	0	0	0
118 Randolph	08/25/1996	07:36 PM	Tstm Wind	50 kts.	0	0	0	0
119 Farmington	10/16/1996	06:04 PM	Hail	1.00 in.	0	0	0	0
120 Coates	10/16/1996	07:00 PM	Hail	1.25 in.	0	0	0	0
121 Coates	10/16/1996	07:25 PM	Hail	1.00 in.	0	0	0	0
122 MNZ041>045 - 047>070 - 073>078 -	10/29/1996	09:00 PM	High Wind	64 kts.	0	0	0	0

082>085 - 091>093								
123 MNZ065>070 - 073>078 - 082>085 - 091>093	11/14/1996	10:00 PM	Ice Storm	N/A	0	0	0	0
124 MNZ041>044 - 047>070 - 074>078 - 082>085 - 091>093	11/20/1996	02:00 AM	Heavy Snow	N/A	0	0	0	0
125 MNZ054 - 056>070 - 073>078 - 082>085 - 091>093	11/22/1996	09:00 PM	Heavy Snow	N/A	0	0	0	0
126 MNZ049>054 - 056>070 - 073>078 - 082>085 - 091>093	12/14/1996	01:00 PM	Heavy Snow	N/A	0	0	0	0
127 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	12/23/1996	05:00 AM	Winter Storm	N/A	1	0	0	0
128 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	12/24/1996	06:00 PM	Extreme Cold	N/A	0	0	0	0
129 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	01/15/1997	05:00 PM	Extreme Windchill	N/A	0	0	0	0
130 MNZ041>045 - 048>053 - 059>063 - 068>070 - 076>078 - 084>085 - 093	03/13/1997	12:00 AM	Winter Storm	N/A	0	0	0	0
131 MNZ054>056 - 060 - 064>065 - 067>070 - 073>076 - 083	03/15/1997	06:00 AM	Flood	N/A	0	0	0	0
132 MNZ054>056 -	04/01/1997	12:00 AM	Flood	N/A	0	0	0	0

060 - 064>065 - 067>070 - 073 - 075>076 - 083								
133 MNZ043 - 049>051 - 059>063 - 070	04/04/1997	06:00 AM	Flood	N/A	0	0	0	0
134 MNZ054>056 - 060 - 064>065 - 067>070 - 073 - 075>076 - 083	05/01/1997	12:00 AM	Flood	N/A	0	0	0	0
135 Farmington	06/07/1997	12:17 PM	Hail	1.00 in.	0	0	0	0
136 South St Paul	06/28/1997	03:00 PM	Tstm Wind	50 kts.	0	0	0	0
137 Apple Vly	07/13/1997	07:25 PM	Tstm Wind	60 kts.	0	0	0	0
138 Farmington	07/16/1997	10:58 PM	Hail	1.75 in.	0	0	0	0
139 Inver Grove Heights	07/16/1997	11:00 PM	Flash Flood	N/A	0	0	0	0
140 Inver Grove Heights	07/16/1997	11:15 PM	Hail	2.75 in.	0	0	0	0
141 Inver Grove Heights	07/16/1997	11:30 PM	Hail	0.88 in.	0	0	0	0
142 Eagan	07/16/1997	11:55 PM	Hail	0.88 in.	0	0	0	0
143 Farmington	07/17/1997	01:54 AM	Tstm Wind	61 kts.	0	0	0	0
144 Hastings	07/17/1997	02:08 AM	Tstm Wind	55 kts.	0	0	0	0

145 Inver Grove Heights	07/17/1997	12:27 AM	Hail	1.00 in.	0	0	0	0
146 Inver Grove Heights	07/17/1997	12:39 AM	Hail	1.00 in.	0	0	0	0
147 Eagan	07/22/1997	01:00 AM	Flash Flood	N/A	0	0	0	0
148 Miesville	08/15/1997	05:50 PM	Hail	0.75 in.	0	0	0	0
149 Burnsville	10/06/1997	06:30 AM	Hail	0.75 in.	0	0	0	0
150 MNZ063 - 069>070 - 076>078 - 083>085 - 091>093	01/04/1998	02:00 PM	Ice Storm	N/A	0	0	0	0
151 Burnsville	03/29/1998	03:18 PM	Hail	0.75 in.	0	0	0	0
152 Castle Rock	03/29/1998	06:25 PM	Tornado	F2	0	0	0	0
153 Farmington	03/29/1998	06:38 PM	Hail	1.75 in.	0	0	0	0
154 Hastings	03/29/1998	06:43 PM	Tornado	F0	0	0	0	0
155 Inver Grove Heights	03/29/1998	06:43 PM	Hail	2.00 in.	0	0	0	0
156 Burnsville	05/15/1998	03:21 PM	Tstm Wind	61 kts.	0	0	0	0
157 Farmington	05/15/1998	03:24 PM	Tstm Wind	61 kts.	0	0	0	0
158 Eagan	05/15/1998	03:27 PM	Hail	0.75 in.	0	0	0	0
159 Burnsville	05/15/1998	03:29 PM	Hail	1.00 in.	0	0	100.0M	0

160 Lakeville	05/15/1998	03:30 PM	Tstm Wind	55 kts.	0	0	0	0
161 Mendota Hgts	05/18/1998	08:30 PM	Hail	1.00 in.	0	0	0	0
162 Farmington	05/28/1998	12:00 AM	Hail	1.00 in.	0	0	0	0
163 Lakeville	05/28/1998	12:18 AM	Hail	0.75 in.	0	0	0	0
164 Hastings	05/28/1998	12:51 AM	Tstm Wind	52 kts.	0	0	0	0
165 Burnsville	05/30/1998	09:49 PM	Tstm Wind	80 kts.	0	7	140.0M	0
166 Apple Vly	05/30/1998	09:52 PM	Tstm Wind	65 kts.	0	0	10.2M	0
167 Eagan	05/30/1998	09:52 PM	Tstm Wind	75 kts.	0	1	24.0M	0
168 Farmington	05/30/1998	09:54 PM	Tstm Wind	70 kts.	0	0	0	0
169 West St Paul	05/30/1998	09:54 PM	Tstm Wind	70 kts.	0	0	0	0
170 Inver Grove Heights	05/30/1998	09:55 PM	Tstm Wind	75 kts.	0	0	0	0
171 Lakeville	05/30/1998	09:55 PM	Tstm Wind	80 kts.	0	0	0	0
172 Rosemount	05/30/1998	09:55 PM	Tstm Wind	70 kts.	0	0	0	0
173 South St Paul	05/30/1998	09:55 PM	Tstm Wind	70 kts.	0	11	0	0

174 Hastings	05/30/1998	09:57 PM	Tstm Wind	70 kts.	0	0	0	0
175 Hastings	05/30/1998	10:02 PM	Tstm Wind	75 kts.	0	0	0	0
176 South St Paul	06/24/1998	12:36 AM	Tstm Wind	50 kts.	0	0	0	0
177 Burnsville	06/25/1998	12:12 AM	Hail	1.00 in.	0	0	0	0
178 Farmington	06/26/1998	08:10 PM	Tstm Wind	70 kts.	0	0	0	0
179 Farmington	06/26/1998	08:15 PM	Flash Flood	N/A	0	0	0	0
180 Waterford	06/26/1998	08:20 PM	Hail	1.00 in.	0	0	0	0
181 Castle Rock	06/26/1998	09:10 PM	Tstm Wind	60 kts.	0	0	0	0
182 Apple Vly	07/14/1998	09:40 PM	Tstm Wind	50 kts.	0	0	0	0
183 MNZ047>049 - 054>058 - 060 - 064>070 - 073>078 - 082>085 - 091>093	01/01/1999	11:00 AM	Heavy Snow	N/A	0	0	0	0
184 MNZ041 - 041>045 - 045 - 047>050 - 050>052 - 052>053 - 053>054 - 054>056 - 056>057 - 057>060 - 060>066 - 066>068 - 068>070 - 070 - 073>074 - 074>076 - 076>078 - 078 - 082>083 -	03/08/1999	12:30 AM	Winter Storm	N/A	0	0	0	0

083>085 - 091 - 091>092								
185 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	03/17/1999	11:00 AM	High Wind	55 kts.	0	0	0	0
186 Eagan	06/05/1999	04:00 PM	Hail	0.88 in.	0	0	0	0
187 Inver Grove Heights	06/05/1999	04:50 PM	Hail	1.00 in.	0	0	0	0
188 Rosemount	06/22/1999	03:25 PM	Tstm Wind	55 kts.	0	0	0	0
189 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/23/1999	10:00 AM	Excessive Heat	N/A	1	0	0	0
190 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/29/1999	03:00 AM	Excessive Heat	N/A	0	0	0	0
191 Apple Vly	07/30/1999	05:55 PM	Tstm Wind	52 kts.	0	0	0	0
192 Castle Rock	08/12/1999	08:33 PM	Tornado	F0	0	0	0	0
193 Burnsville	09/07/1999	06:55 PM	Hail	1.00 in.	0	0	0	0
194 MNZ070 - 073>078 - 082>085	10/01/1999	05:00 PM	Early Snowfall	N/A	0	0	0	0
195 MNZ047>049 - 051 - 055>063 - 066 - 068>070 - 078	01/12/2000	05:30 AM	Heavy Snow	N/A	0	0	0	0
196 MNZ054>070 - 073>078 - 082>085 - 091>093	01/19/2000	05:30 AM	Heavy Snow	N/A	0	0	0	0

197 MNZ041 - 047>049 - 054>060 - 062>070 - 073>078 - 082>085 - 091>093	04/05/2000	09:00 PM	High Wind	64 kts.	0	0	0	0
198 Burnsville	07/07/2000	10:40 PM	Hail	1.00 in.	0	0	0	0
199 Apple Vly	07/07/2000	10:45 PM	Hail	0.75 in.	0	0	0	0
200 Eagan	07/07/2000	10:45 PM	Hail	0.75 in.	0	0	0	0
201 Eagan	07/07/2000	10:50 PM	Tstm Wind	50 kts.	0	0	0	0
202 Eagan	07/07/2000	11:00 PM	Flash Flood	N/A	1	0	20.0M	0
203 Burnsville	07/07/2000	11:30 PM	Hail	0.88 in.	0	0	0	0
204 MNZ041>045 - 047>053 - 055>063 - 065>070 - 076>078 - 084>085 - 093	12/28/2000	02:00 AM	Winter Storm	N/A	0	0	0	0
205 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	01/29/2001	07:00 PM	Winter Storm	N/A	0	0	0	0
206 MNZ054 - 056 - 060 - 064>070 - 073>078	02/07/2001	06:00 AM	Heavy Snow	N/A	0	0	0	0
207 MNZ048>049 - 054>070 - 075>078 - 083 - 085 - 093	03/11/2001	11:00 PM	Heavy Snow	N/A	0	0	0	0
208 MNZ041>045 - 047>070 - 073>078 -	03/30/2001	12:00 AM	Fog	N/A	0	0	0	0

082>085 - 091>093								
209 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	04/01/2001	12:00 PM	Flood	N/A	3	1	200.0M	0
210 MNZ063 - 067 - 069>070 - 073>078 - 082>085 - 091>093	04/07/2001	08:00 AM	High Wind	69 kts.	0	0	8.0M	0
211 Apple Vly	05/01/2001	05:00 PM	Hail	0.75 in.	0	0	0	0
212 Farmington	05/01/2001	05:00 PM	Hail	1.50 in.	0	0	0	0
213 MNZ054>056 - 059>060 - 062>070 - 073>076 - 078 - 083	05/01/2001	12:00 AM	Flood	N/A	0	0	0	0
214 Farmington	05/09/2001	07:05 PM	Hail	0.75 in.	0	0	0	0
215 Northfield	05/09/2001	07:08 PM	Tornado	F2	0	0	7.0M	0
216 Burnsville	06/01/2001	02:40 PM	Hail	0.75 in.	0	0	0	0
217 Hastings	06/11/2001	03:29 PM	Hail	0.88 in.	0	0	0	0
218 Burnsville	06/11/2001	04:55 PM	Hail	1.25 in.	0	0	500K	0
219 Burnsville	06/11/2001	04:55 PM	Tstm Wind	55 kts.	0	0	0	0
220 Eagan	06/11/2001	05:05 PM	Hail	1.00 in.	0	0	0	0
221 Apple Vly	06/13/2001	05:30 AM	Lightning	N/A	0	0	80K	0

222 Burnsville	06/13/2001	10:30 PM	Tstm Wind	50 kts.	0	0	0	0
223 Lakeville	06/13/2001	10:30 PM	Tstm Wind	52 kts.	0	0	0	0
224 Farmington	06/13/2001	10:35 PM	Tstm Wind	55 kts.	0	0	0	0
225 Apple Vly	06/14/2001	12:30 AM	Lightning	N/A	0	0	25K	0
226 Burnsville	06/18/2001	06:50 AM	Hail	0.75 in.	0	0	0	0
227 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/30/2001	09:00 AM	Excessive Heat	N/A	0	0	0	0
228 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	08/01/2001	12:00 AM	Excessive Heat	N/A	1	0	0	0
229 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	08/04/2001	12:00 PM	Excessive Heat	N/A	5	0	0	0
230 Lakeville	09/09/2001	05:55 PM	Tornado	F0	0	0	0	0
231 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	03/08/2002	06:00 PM	Winter Storm	N/A	0	0	0	0
232 MNZ042>045 - 048>070 - 073>078 - 082>085 - 091	03/14/2002	08:00 AM	Winter Storm	N/A	0	0	0	0
233 Burnsville	04/18/2002	02:12 AM	Hail	0.75 in.	0	0	0	0
234 Burnsville	04/18/2002	02:21 AM	Hail	1.00 in.	0	0	0	0

235 Burnsville	04/18/2002	02:24 AM	Hail	1.75 in.	0	0	0	0
236 Apple Vly	04/18/2002	02:32 AM	Hail	1.50 in.	0	0	0	0
237 Lakeville	04/18/2002	02:32 AM	Hail	0.75 in.	0	0	0	0
238 Eagan	04/18/2002	02:45 AM	Hail	0.75 in.	0	0	0	0
239 Burnsville	04/18/2002	03:00 AM	Hail	1.00 in.	0	0	0	0
240 Apple Vly	04/18/2002	03:05 AM	Hail	1.25 in.	0	0	0	0
241 Inver Grove Heights	04/18/2002	03:09 AM	Hail	2.00 in.	0	0	0	0
242 South St Paul	04/18/2002	03:09 AM	Hail	2.00 in.	0	0	0	0
243 Burnsville	04/18/2002	03:30 AM	Hail	1.00 in.	0	0	0	0
244 Eagan	04/18/2002	03:30 AM	Hail	1.00 in.	0	0	0	0
245 Castle Rock	05/08/2002	02:43 PM	Hail	0.88 in.	0	0	0	0
246 Mendota Hgts	06/10/2002	10:50 PM	Tstm Wind	50 kts.	0	0	0	0
247 Farmington	07/28/2002	05:31 PM	Hail	0.75 in.	0	0	0	0
248 West Portion	08/03/2002	07:00 PM	Flash Flood	N/A	0	0	0	0
249 Farmington	08/16/2002	10:40 PM	Hail	0.75	0	0	0	0

				in.				
250 Hampton	08/16/2002	10:50 PM	Tstm Wind	55 kts.	0	0	0	0
251 Apple Vly	07/04/2003	02:12 AM	Tstm Wind	50 kts.	0	0	0	0
252 Farmington	07/04/2003	02:20 AM	Tstm Wind	56 kts.	0	0	0	0
253 MNZ041>045 - 047>070 - 073>076 - 082>083 - 091	11/22/2003	06:00 PM	Winter Storm	N/A	0	0	0	0
254 MNZ053 - 060>063 - 065>070 - 073>078 - 083>085 - 091>093	12/09/2003	03:00 AM	Winter Storm	N/A	0	0	0	0
255 MNZ041>045 - 047>052 - 054>070 - 073>078 - 082>085 - 091>093	01/24/2004	09:00 PM	Winter Storm	N/A	0	0	0	0
256 MNZ044>045 - 051>052 - 059>063 - 065>070 - 073>078 - 082>085 - 091>093	02/01/2004	02:00 AM	Winter Storm	N/A	0	0	0	0
257 MNZ060 - 062>063 - 068>070 - 076>078 - 083>085 - 091>093	03/05/2004	12:00 AM	Winter Storm	N/A	0	0	0	0
258 MNZ053 - 060>063 - 067>070 - 073>078 - 082>085 - 091>093	04/18/2004	01:00 PM	High Wind	52 kts.	0	0	0	0
259 Lakeville	04/18/2004	07:05 PM	Tstm Wind	65	0	0	0	0

				kts.				
260 Apple Vly	04/18/2004	07:10 PM	Tstm Wind	50 kts.	0	0	0	0
261 Farmington	04/18/2004	07:12 PM	Tstm Wind	57 kts.	0	0	0	0
262 Farmington	04/18/2004	12:00 AM	Hail	2.00 in.	0	0	0	0
263 Hampton	04/18/2004	12:02 AM	Hail	1.75 in.	0	0	0	0
264 Lakeville	05/09/2004	06:00 PM	Hail	0.75 in.	0	0	0	0
265 Apple Vly	05/09/2004	06:01 PM	Hail	0.75 in.	0	0	0	0
266 Hastings	05/09/2004	06:15 PM	Hail	0.75 in.	0	0	0	0
267 Eagan	06/23/2004	03:30 PM	Tstm Wind	52 kts.	0	0	0	0
268 Northfield	06/23/2004	04:06 PM	Tstm Wind	50 kts.	0	0	0	0
269 Burnsville	08/01/2004	09:51 AM	Hail	0.75 in.	0	0	0	0
270 Apple Vly	08/01/2004	10:00 AM	Hail	0.75 in.	0	0	0	0
271 MNZ066 - 070 - 078	09/15/2004	11:00 AM	Strong Wind	40 kts.	0	0	1K	0
272 Waterford	10/08/2004	11:30 AM	Lightning	N/A	0	0	0	0
273 MNZ041>043 - 047>051 - 054>059 -	12/12/2004	06:00 AM	High Wind	40 kts.	0	0	0	0

064>070 - 073>078 - 082>085 - 091>093								
274 MNZ044>045 - 049>070 - 073>078 - 082>085 - 091>093	01/01/2005	10:00 AM	Winter Storm	N/A	0	0	0	0
275 MNZ042>045 - 049>053 - 059>063 - 068>070 - 078	01/21/2005	10:00 AM	Winter Storm	N/A	0	0	0	0
276 MNZ070 - 077>078 - 085	02/19/2005	06:00 PM	Winter Storm	N/A	0	0	0	0
277 MNZ060 - 062>063 - 065>070 - 073>078 - 082>085 - 091>093	03/18/2005	12:00 AM	Winter Storm	N/A	0	0	0	0
278 Hampton	05/08/2005	07:30 PM	Funnel Cloud	N/A	0	0	0	0
279 Lakeville	06/07/2005	11:04 PM	Hail	0.75 in.	0	0	0	0
280 Burnsville	06/08/2005	03:00 AM	Tstm Wind	52 kts.	0	0	0	0
281 West St Paul	06/08/2005	03:10 AM	Tstm Wind	52 kts.	0	0	0	0
282 St Paul Arpt	06/08/2005	03:11 AM	Tstm Wind	51 kts.	0	0	0	0
283 Hampton	06/08/2005	03:30 AM	Tstm Wind	52 kts.	0	0	0	0
284 Burnsville	06/08/2005	04:30 AM	Lightning	N/A	0	0	0	0
285 Eagan	06/20/2005	01:00 PM	Tstm Wind	50 kts.	0	0	0	0
286 Inver Grove	06/20/2005	01:00 PM	Tstm Wind	50	0	0	0	0

Heights				kts.				
287 West St Paul	06/20/2005	01:02 PM	Tstm Wind	50 kts.	0	0	0	0
288 Inver Grove Heights	06/20/2005	01:10 PM	Tstm Wind	50 kts.	0	0	0	0
289 Apple Vly	06/24/2005	05:27 AM	Tstm Wind	50 kts.	0	0	0	0
290 Lakeville	06/24/2005	05:30 AM	Tstm Wind	55 kts.	0	0	0	0
291 Farmington	06/24/2005	05:40 AM	Tstm Wind	61 kts.	0	0	500K	0
292 Hastings	06/24/2005	05:52 AM	Hail	1.00 in.	0	0	1.0M	0
293 Hastings	06/24/2005	05:52 AM	Tstm Wind	52 kts.	0	0	0	0
294 Burnsville	06/27/2005	06:40 PM	Hail	0.75 in.	0	0	0	0
295 Eagan	06/29/2005	09:00 PM	Hail	1.00 in.	0	0	0	0
296 Mendota Hgts	06/29/2005	09:00 PM	Hail	1.00 in.	0	0	0	0
297 Burnsville	06/29/2005	09:04 PM	Hail	0.88 in.	0	0	0	0
298 Farmington	07/17/2005	07:45 PM	Lightning	N/A	0	0	75K	0
299 West St Paul	08/04/2005	12:00 AM	Tstm Wind	52 kts.	0	0	0	0
300 Inver Grove Heights	08/08/2005	03:30 AM	Hail	0.75 in.	0	0	0	0

301 Mendota Hgts	08/08/2005	05:00 AM	Tstm Wind	50 kts.	0	0	0	0
302 Farmington	08/09/2005	02:30 PM	Tstm Wind	50 kts.	0	0	0	0
303 Miesville	08/09/2005	02:48 PM	Tstm Wind	52 kts.	0	0	0	0
304 West St Paul	09/04/2005	06:00 AM	Heavy Rain	N/A	0	0	0	0
305 Eagan	09/12/2005	09:55 PM	Tstm Wind	52 kts.	0	0	0	0
306 Burnsville	09/12/2005	10:03 PM	Hail	0.75 in.	0	0	0	0
307 Eagan	09/12/2005	10:45 PM	Tstm Wind	52 kts.	0	0	0	0
308 Lakeville	09/12/2005	11:00 PM	Hail	1.50 in.	0	0	0	0
309 West St Paul	09/21/2005	06:55 PM	Tstm Wind	50 kts.	0	0	0	0
310 Burnsville	09/21/2005	10:35 PM	Hail	0.88 in.	0	0	0	0
311 Burnsville	10/04/2005	06:03 AM	Lightning	N/A	0	0	0	0
312 Burnsville	10/04/2005	06:15 AM	Lightning	N/A	0	0	0	0
313 Countywide	10/04/2005	07:00 PM	Flash Flood	N/A	0	0	0	0
314 MNZ070	10/04/2005	11:00 PM	Flood	N/A	0	0	0	0
315 MNZ049>050 - 052>053 - 059 - 063 - 066>070 - 076 - 078 - 083 - 085 - 092>093	12/13/2005	08:00 PM	Heavy Snow	N/A	0	0	0	0
316 MNZ051>054 -	03/12/2006	12:00 PM	Winter Storm	N/A	0	0	0	0

056>070 - 073>078 - 082>085 - 091>093								
317 MNZ051 - 059>063 - 068>070 - 078	03/15/2006	08:00 PM	Winter Storm	N/A	0	0	0	0
318 Apple Vly	04/18/2006	07:22 PM	Hail	0.75 in.	0	0	0	0
319 Lakeville	06/24/2006	03:34 PM	Hail	1.00 in.	0	0	0	0
320 Farmington	06/24/2006	03:40 PM	Tstm Wind	50 kts.	0	0	0	0
321 St Paul Arpt	07/24/2006	04:43 PM	Tstm Wind	54 kts.	0	0	0	0
322 South St Paul	07/24/2006	04:45 PM	Tstm Wind	54 kts.	0	0	0	0
323 Farmington	07/24/2006	05:00 PM	Lightning	N/A	0	0	1.0M	0
324 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/30/2006	10:00 AM	Heat	N/A	0	0	0	0
325 Lakeville	08/02/2006	02:00 AM	Lightning	N/A	0	0	100K	0
326 Lakeville	08/24/2006	09:30 AM	Hail	1.75 in.	0	0	0	0
327 Northfield	08/24/2006	09:34 AM	Hail	1.25 in.	0	0	0	0
328 Lakeville	08/24/2006	10:33 AM	Hail	1.75 in.	0	0	0	0
329 Apple Vly	08/24/2006	10:40 AM	Hail	2.00 in.	0	0	10.0M	0

330 Eagan	10/03/2006	21:05 PM	Hail	0.88 in.	0	0	0K	0K
331 Inver Grove Heights	10/03/2006	21:15 PM	Hail	0.75 in.	0	0	0K	0K
332 Inver Grove Heights	10/03/2006	21:22 PM	Hail	0.75 in.	0	0	0K	0K
333 Lakeville	10/03/2006	22:16 PM	Hail	0.75 in.	0	0	0K	0K
334 Lakeville	10/03/2006	22:20 PM	Hail	1.25 in.	0	0	0K	0K
335 MNZ070 - 078	01/14/2007	16:00 PM	Heavy Snow	N/A	0	0	0K	0K
336 MNZ060 - 068 - 070	02/23/2007	22:00 PM	Winter Storm	N/A	0	0	0K	0K
337 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091	03/01/2007	00:00 AM	Winter Storm	N/A	0	0	0K	0K
338 Hampton	03/25/2007	15:23 PM	Funnel Cloud	N/A	0	0	0K	0K
339 MNZ060>062 - 070 - 077	05/06/2007	09:30 AM	High Wind	50 kts.	0	0	0K	0K
340 West St Paul	06/02/2007	13:33 PM	Hail	0.75 in.	0	0	0K	0K
341 Eagan	06/02/2007	15:10 PM	Hail	0.75 in.	0	0	0K	0K
342 West St Paul	06/02/2007	15:26 PM	Hail	0.88 in.	0	0	0K	0K
343 West St Paul	06/02/2007	15:30 PM	Thunderstorm Wind	52 kts.	0	0	0K	0K
344 Lakeville	06/07/2007	02:00 AM	Hail	1.00	0	0	0K	0K

				in.				
345 Apple Vly	06/07/2007	02:05 AM	Hail	1.00 in.	0	0	0K	0K
346 Burnsville	06/07/2007	02:07 AM	Hail	0.75 in.	0	0	0K	0K
347 Coates	06/07/2007	02:15 AM	Hail	1.75 in.	0	0	0K	0K
348 South St Paul	06/20/2007	20:58 PM	Hail	0.88 in.	0	0	0K	0K
349 Inver Grove Heights	06/20/2007	21:04 PM	Hail	0.75 in.	0	0	0K	0K
350 Hastings	06/20/2007	21:26 PM	Hail	3.00 in.	0	0	12.0M	0K
351 Eagan	07/08/2007	14:57 PM	Hail	1.75 in.	0	0	0K	0K
352 South St Paul	07/26/2007	14:30 PM	Thunderstorm Wind	52 kts.	0	0	0K	0K
353 Inver Grove Heights	08/11/2007	19:01 PM	Hail	1.00 in.	0	0	0K	0K
354 Lakeville	08/11/2007	19:38 PM	Hail	0.75 in.	0	0	0K	0K
355 Burnsville	08/13/2007	22:39 PM	Hail	0.75 in.	0	0	0K	0K
356 Lakeville	08/13/2007	22:50 PM	Hail	0.75 in.	0	0	0K	0K
357 Burnsville	08/28/2007	02:00 AM	Thunderstorm Wind	50 kts.	0	0	0K	0K
358 Lakeville	08/28/2007	02:00 AM	Thunderstorm	55	0	0	0K	0K

			Wind	kts.				
359 Inver Grove Heights	08/28/2007	02:10 AM	Thunderstorm Wind	55 kts.	0	0	0K	0K
360 Hastings	08/28/2007	02:20 AM	Thunderstorm Wind	52 kts.	0	0	0K	0K
361 Castle Rock	08/28/2007	11:00 AM	Hail	1.50 in.	0	0	0K	0K
362 Castle Rock	08/28/2007	11:00 AM	Thunderstorm Wind	52 kts.	0	0	0K	0K
363 MNZ053 - 060>063 - 066>070 - 073>078 - 082>083 - 085 - 091	11/19/2007	22:30 PM	Dense Fog	N/A	0	0	0K	0K
364 MNZ043 - 049 - 053 - 061>063 - 070	12/01/2007	09:30 AM	Winter Storm	N/A	0	0	0K	0K
365 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091	02/10/2008	02:00 AM	Cold/wind Chill	N/A	0	0	0K	0K
366 MNZ041>045 - 047>070 - 073	02/19/2008	18:00 PM	Cold/wind Chill	N/A	0	0	0K	0K
367 MNZ054>056 - 060 - 064 - 070 - 078	03/20/2008	20:00 PM	Winter Storm	N/A	0	0	0K	0K
368 MNZ060>063 - 070 - 076>077 - 084	03/31/2008	09:00 AM	Heavy Snow	N/A	0	0	0K	0K
369 MNZ044 - 049>053 - 058>063 - 066>070 - 076>078 - 084	04/01/2008	00:00 AM	Heavy Snow	N/A	0	0	0K	0K
370 Orchard Gardens	05/31/2008	17:42 PM	Thunderstorm Wind	60 kts.	0	0	0K	0K

371 Eagan	05/31/2008	17:48 PM	Hail	1.75 in.	0	0	0K	0K
372 Rosemount	05/31/2008	18:00 PM	Hail	1.00 in.	0	0	0K	0K
373 Hampton	05/31/2008	18:10 PM	Hail	0.75 in.	0	0	0K	0K
				TOTALS:	16	35	543.138M	0

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Search Field: Search NCDC

Query Results

280 event(s) were reported in **Goodhue County, Minnesota** between **01/01/1950** and **05/31/2008 (High Wind limited to speed greater than 0 knots)**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Minnesota

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 GOODHUE	08/08/1963	2315	Hail	2.50 in.	0	0	0	0
2 GOODHUE	07/16/1967	1858	Tornado	F0	0	0	0K	0
3 GOODHUE	05/15/1968	1530	Tstm Wind	0 kts.	0	0	0	0
4 GOODHUE	06/13/1968	2100	Tstm Wind	0 kts.	0	0	0	0
5 GOODHUE	09/08/1968	0333	Hail	1.75 in.	0	0	0	0
6 GOODHUE	07/13/1969	0740	Tstm Wind	52 kts.	0	0	0	0

7 GOODHUE	07/15/1969	2100	Tornado	F1	0	0	25K	0
8 GOODHUE	09/21/1970	0245	Tstm Wind	0 kts.	0	0	0	0
9 GOODHUE	06/07/1971	1330	Tornado	F0	0	0	0K	0
10 GOODHUE	06/10/1971	2315	Hail	1.00 in.	0	0	0	0
11 GOODHUE	07/01/1973	2210	Tstm Wind	0 kts.	0	0	0	0
12 GOODHUE	08/21/1975	0600	Tstm Wind	0 kts.	0	0	0	0
13 GOODHUE	05/15/1977	1430	Tstm Wind	61 kts.	0	0	0	0
14 GOODHUE	07/15/1978	2000	Hail	1.75 in.	0	0	0	0
15 GOODHUE	07/12/1979	1439	Hail	1.75 in.	0	0	0	0
16 GOODHUE	07/12/1979	1439	Tstm Wind	52 kts.	0	0	0	0
17 GOODHUE	07/11/1980	2315	Hail	1.00 in.	0	0	0	0
18 GOODHUE	07/11/1980	2330	Tstm Wind	0 kts.	0	0	0	0
19 GOODHUE	07/15/1980	1935	Tstm Wind	0 kts.	0	0	0	0
20 GOODHUE	07/15/1980	1935	Tstm Wind	52 kts.	0	0	0	0
21 GOODHUE	07/24/1981	1715	Tstm Wind	0 kts.	0	0	0	0

22 GOODHUE	07/19/1983	1605	Tstm Wind	0 kts.	0	0	0	0
23 GOODHUE	07/19/1983	1610	Tstm Wind	0 kts.	0	0	0	0
24 GOODHUE	08/15/1983	1600	Hail	1.75 in.	0	0	0	0
25 GOODHUE	08/15/1983	1600	Tstm Wind	68 kts.	0	0	0	0
26 GOODHUE	04/26/1984	2100	Tstm Wind	0 kts.	0	0	0	0
27 GOODHUE	06/07/1984	1935	Tornado	F0	0	0	25K	0
28 GOODHUE	06/17/1984	1800	Tornado	F0	0	0	0K	0
29 GOODHUE	06/26/1984	1506	Tstm Wind	0 kts.	0	0	0	0
30 GOODHUE	05/30/1985	1625	Hail	2.50 in.	0	0	0	0
31 GOODHUE	05/30/1985	1625	Tstm Wind	0 kts.	0	0	0	0
32 GOODHUE	07/15/1986	1100	Tstm Wind	0 kts.	0	0	0	0
33 GOODHUE	08/17/1986	0130	Tstm Wind	0 kts.	0	0	0	0
34 GOODHUE	05/10/1987	1640	Tornado	F0	0	0	0K	0
35 GOODHUE	06/28/1987	1800	Tstm Wind	0 kts.	0	0	0	0
36 GOODHUE	07/27/1987	1420	Tornado	F3	0	0	2.5M	0
37 GOODHUE	07/27/1987	1530	Tstm Wind	0 kts.	0	0	0	0

38 GOODHUE	05/07/1988	1800	Tstm Wind	52 kts.	0	0	0	0
39 GOODHUE	05/07/1988	1800	Tstm Wind	52 kts.	0	0	0	0
40 GOODHUE	06/14/1988	1815	Tstm Wind	0 kts.	0	0	0	0
41 GOODHUE	08/03/1988	1830	Hail	1.75 in.	0	0	0	0
42 GOODHUE	05/23/1989	1725	Hail	2.75 in.	0	0	0	0
43 GOODHUE	05/23/1989	1740	Hail	1.00 in.	0	0	0	0
44 GOODHUE	06/02/1990	1150	Tornado	F1	0	0	25K	0
45 GOODHUE	06/12/1990	1725	Tstm Wind	0 kts.	0	0	0	0
46 GOODHUE	06/12/1990	1750	Hail	1.75 in.	0	0	0	0
47 GOODHUE	05/28/1991	0925	Hail	0.75 in.	0	0	0	0
48 GOODHUE	05/28/1991	0938	Tstm Wind	0 kts.	0	0	0	0
49 GOODHUE	06/14/1992	1856	Hail	0.90 in.	0	0	0	0
50 GOODHUE	07/02/1992	0320	Tstm Wind	0 kts.	0	0	0	0
51 GOODHUE	07/02/1992	0345	Tstm Wind	0 kts.	0	0	0	0
52 GOODHUE	09/04/1992	0725	Hail	0.88	0	0	0	0

				in.				
53 MNZ003 - 012 - 019>021 - 027 - 038 - 041>045 - 050>053 - 061>063 - 070 - 078 -	01/05/1994	1100	Heavy Snow	N/A	0	0	0	0
54 All Of Minnesota	01/15/1994	0100	Extreme Cold	N/A	1	0	0	0
55 Southern Mn	04/15/1994	0900	High Wind	0 kts.	0	0	0	0
56 MNZ011 - 012 - 018>021 - 025 - 026 - 032>038 - 040>096	04/28/1994	0400	Heavy Snow And Ice	N/A	0	0	0	0
57 GOODHUE	07/06/1994	0100	Flash Flood	N/A	0	0	50K	0
58 MNZ075>079 - 083>088 - 092>096	11/18/1994	0700	High Wind	52 kts.	0	0	0	0
59 MNZ020 - 021 - 029>098	11/27/1994	0500	Heavy Snow/ice	N/A	0	0	0	0
60 Kenyon	06/22/1995	1400	Thunderstorm Winds/heavy Rain	0 kts.	0	0	0	0
61 South And Portions Of	07/10/1995	1300	Heat Wave	N/A	2	0	2.0M	0
62 Portions Of Central M	11/26/1995	1500	Heavy Snow	N/A	0	0	0	0
63 Central And South Mn	12/08/1995	0300	Heavy Snow	N/A	0	0	0	0

64 Central And South Mn	12/08/1995	1400	Low Wind Chill	N/A	0	0	0	0
65 Central And South Mn	12/13/1995	0200	Glaze	N/A	0	0	0	0
66 MNZ058>063 - 065>070 - 074>079 - 083>086	01/10/1996	01:00 PM	Heavy Snow	N/A	0	0	0	0
67 MNZ077>078 - 084>088 - 093>096	01/17/1996	02:00 PM	Heavy Snow	N/A	0	0	0	0
68 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	01/18/1996	06:00 PM	Extreme Windchill	N/A	0	0	0	0
69 MNZ074>079 - 082>088 - 091>096	01/25/1996	02:00 AM	Heavy Snow	N/A	0	0	0	0
70 MNZ041 - 047>048 - 054>057 - 064>065 - 073>078 - 082>088 - 091>096	01/28/1996	11:00 PM	Blizzard	N/A	0	0	0	0
71 MNZ041>045 - 047>070 - 073>079 - 082>088 - 091>096	01/31/1996	04:00 AM	Extreme Cold	N/A	0	0	0	0
72 MNZ041>045	02/01/1996	12:00 AM	Extreme Cold	N/A	0	0	0	0

- 047>070 - 073>079 - 082>088 - 091>096								
73 MNZ041 - 047>048 - 054>057 - 064 - 067 - 074>079 - 082>088 - 091>096	02/10/1996	09:00 AM	High Wind	48 kts.	0	0	0	0
74 MNZ042>045 - 049>054 - 056>070 - 073>079 - 082>087 - 091>093	03/23/1996	09:00 PM	Heavy Snow	N/A	0	0	0	0
75 Zumbrota	05/19/1996	01:15 AM	Tstm Wind	65 kts.	0	0	0	0
76 Pine Island	05/19/1996	01:20 AM	Tstm Wind	65 kts.	0	0	0	0
77 Welch	05/19/1996	12:45 AM	Tstm Wind	65 kts.	0	0	0	0
78 Red Wing	06/29/1996	01:35 PM	Tstm Wind	60 kts.	0	0	0	0
79 Cannon Falls	08/25/1996	07:25 PM	Hail	0.75 in.	0	0	0	0
80 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	10/29/1996	09:00 PM	High Wind	64 kts.	0	0	0	0

81 MNZ065>070 - 073>078 - 082>085 - 091>093	11/14/1996	10:00 PM	Ice Storm	N/A	0	0	0	0
82 MNZ041>044 - 047>070 - 074>078 - 082>085 - 091>093	11/20/1996	02:00 AM	Heavy Snow	N/A	0	0	0	0
83 MNZ054 - 056>070 - 073>078 - 082>085 - 091>093	11/22/1996	09:00 PM	Heavy Snow	N/A	0	0	0	0
84 MNZ049>054 - 056>070 - 073>078 - 082>085 - 091>093	12/14/1996	01:00 PM	Heavy Snow	N/A	0	0	0	0
85 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	12/23/1996	05:00 AM	Winter Storm	N/A	1	0	0	0
86 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	12/24/1996	06:00 PM	Extreme Cold	N/A	0	0	0	0
87 MNZ041>045 - 047>070 - 073>078 - 082>085 -	01/15/1997	05:00 PM	Extreme Windchill	N/A	0	0	0	0

091>093								
88 MNZ041>045 - 048>053 - 059>063 - 068>070 - 076>078 - 084>085 - 093	03/13/1997	12:00 AM	Winter Storm	N/A	0	0	0	0
89 Red Wing	06/05/1997	11:45 AM	Hail	0.75 in.	0	0	0	0
90 Cannon Falls	06/28/1997	04:00 PM	Tstm Wind	50 kts.	0	0	0	0
91 Vasa	07/01/1997	08:55 PM	Hail	1.75 in.	0	0	0	0
92 Red Wing	07/01/1997	09:15 PM	Hail	1.75 in.	0	0	0	0
93 Red Wing	07/13/1997	08:25 PM	Tstm Wind	55 kts.	0	0	0	0
94 Cannon Falls	07/17/1997	02:15 AM	Tstm Wind	55 kts.	0	0	0	0
95 Zumbrota	07/17/1997	02:30 AM	Tstm Wind	55 kts.	0	0	0	0
96 Red Wing	07/22/1997	01:00 AM	Flash Flood	N/A	0	0	0	0
97 Zumbrota	07/25/1997	03:00 AM	Flash Flood	N/A	0	0	0	0
98 Wanamingo	08/14/1997	06:30 PM	Tornado	F1	0	0	0	0
99 Goodhue	08/14/1997	06:40 PM	Tornado	F0	0	0	0	0
100 MNZ063 - 069>070 - 076>078 - 083>085 -	01/04/1998	02:00 PM	Ice Storm	N/A	0	0	0	0

091>093								
101 Stanton	05/15/1998	08:45 PM	Lightning	N/A	0	0	0	0
102 White Rock	05/15/1998	08:55 PM	Tstm Wind	55 kts.	0	0	1.0M	0
103 Goodhue	05/18/1998	08:50 PM	Tstm Wind	50 kts.	0	0	0	0
104 Cannon Falls	05/18/1998	08:55 PM	Tstm Wind	55 kts.	0	0	0	0
105 Goodhue	05/18/1998	08:55 PM	Tstm Wind	55 kts.	0	0	0	0
106 Kenyon	05/28/1998	01:21 AM	Tstm Wind	55 kts.	0	0	0	0
107 Cannon Falls	05/30/1998	10:00 PM	Tstm Wind	60 kts.	0	1	0	0
108 Zumbrota	05/30/1998	10:15 PM	Tstm Wind	55 kts.	0	0	0	0
109 Cannon Falls	06/25/1998	12:28 AM	Tstm Wind	65 kts.	0	0	0	0
110 Red Wing	06/25/1998	12:28 AM	Tstm Wind	70 kts.	0	0	0	0
111 Vasa	06/25/1998	12:28 AM	Tstm Wind	65 kts.	0	0	0	0
112 Red Wing	06/25/1998	12:45 AM	Tstm Wind	55 kts.	0	0	0	0
113 Kenyon	06/26/1998	09:00 PM	Tstm Wind	55 kts.	0	0	0	0
114 Zumbrota	06/26/1998	09:00 PM	Hail	1.75 in.	0	0	0	0

115 Cannon Falls	06/26/1998	09:15 PM	Flash Flood	N/A	2	0	1.5M	0
116 Goodhue	06/26/1998	10:45 PM	Hail	0.75 in.	0	0	0	0
117 MNZ078	06/27/1998	03:00 AM	Flood	N/A	0	0	0	0
118 Cannon Falls	06/27/1998	06:05 PM	Tornado	F0	0	0	0	0
119 Kenyon	06/27/1998	06:05 PM	Tornado	F0	0	0	0	0
120 Wanamingo	06/27/1998	06:08 PM	Tornado	F0	0	0	0	0
121 Zumbrota	06/27/1998	06:19 PM	Tornado	F0	0	0	0	0
122 MNZ047>049 - 054>058 - 060 - 064>070 - 073>078 - 082>085 - 091>093	01/01/1999	11:00 AM	Heavy Snow	N/A	0	0	0	0
123 MNZ077>078 - 084>085 - 093	01/22/1999	01:00 AM	Winter Storm	N/A	0	0	0	0
124 MNZ041 - 041>045 - 045 - 047>050 - 050>052 - 052>053 - 053>054 - 054>056 - 056>057 - 057>060 - 060>066 - 066>068 - 068>070 - 070 - 073>074 -	03/08/1999	12:30 AM	Winter Storm	N/A	0	0	0	0

074>076 - 076>078 - 078 - 082>083 - 083>085 - 091 - 091>092								
125 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	03/17/1999	11:00 AM	High Wind	55 kts.	0	0	0	0
126 Pine Is	06/05/1999	08:30 PM	Tstm Wind	52 kts.	0	0	0	0
127 Goodhue	06/06/1999	05:05 PM	Tstm Wind	55 kts.	0	0	0	0
128 Red Wing	06/06/1999	05:20 PM	Tstm Wind	50 kts.	0	0	0	0
129 Roscoe	07/08/1999	04:40 PM	Hail	0.75 in.	0	0	0	0
130 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/23/1999	10:00 AM	Excessive Heat	N/A	1	0	0	0
131 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/29/1999	03:00 AM	Excessive Heat	N/A	0	0	0	0
132 Cannon Falls	07/30/1999	06:10 PM	Tstm Wind	52	0	0	0	0

				kts.				
133 Welch	08/09/1999	06:08 PM	Tornado	F0	0	0	0	0
134 Kenyon	08/09/1999	06:45 PM	Funnel Cloud	N/A	0	0	0	0
135 MNZ070 - 073>078 - 082>085	10/01/1999	05:00 PM	Early Snowfall	N/A	0	0	0	0
136 MNZ047>049 - 051 - 055>063 - 066 - 068>070 - 078	01/12/2000	05:30 AM	Heavy Snow	N/A	0	0	0	0
137 MNZ054>070 - 073>078 - 082>085 - 091>093	01/19/2000	05:30 AM	Heavy Snow	N/A	0	0	0	0
138 MNZ041 - 047>049 - 054>060 - 062>070 - 073>078 - 082>085 - 091>093	04/05/2000	09:00 PM	High Wind	64 kts.	0	0	0	0
139 Pine Is	06/10/2000	02:50 PM	Hail	0.75 in.	0	0	0	0
140 Red Wing	07/07/2000	11:15 AM	Hail	0.75 in.	0	0	0	0
141 Red Wing	07/07/2000	11:20 AM	Tstm Wind	55 kts.	0	0	0	0
142 Frontenac	08/01/2000	02:20 PM	Tstm Wind	50 kts.	0	0	0	0

143 MNZ041>045 - 047>053 - 055>063 - 065>070 - 076>078 - 084>085 - 093	12/28/2000	02:00 AM	Winter Storm	N/A	0	0	0	0
144 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	01/29/2001	07:00 PM	Winter Storm	N/A	0	0	0	0
145 MNZ054 - 056 - 060 - 064>070 - 073>078	02/07/2001	06:00 AM	Heavy Snow	N/A	0	0	0	0
146 MNZ048>049 - 054>070 - 075>078 - 083 - 085 - 093	03/11/2001	11:00 PM	Heavy Snow	N/A	0	0	0	0
147 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	03/30/2001	12:00 AM	Fog	N/A	0	0	0	0
148 MNZ041>045 - 047>070 - 073>078 - 082>085 -	04/01/2001	12:00 PM	Flood	N/A	3	1	200.0M	0

091>093								
149 MNZ063 - 067 - 069>070 - 073>078 - 082>085 - 091>093	04/07/2001	08:00 AM	High Wind	69 kts.	0	0	8.0M	0
150 MNZ054>056 - 059>060 - 062>070 - 073>076 - 078 - 083	05/01/2001	12:00 AM	Flood	N/A	0	0	0	0
151 Stanton	05/09/2001	07:13 PM	Tornado	F2	0	0	4.0M	0
152 Cannon Falls	05/09/2001	07:23 PM	Tstm Wind	65 kts.	0	0	200K	0
153 Goodhue	05/09/2001	07:40 PM	Hail	1.75 in.	0	0	0	0
154 Red Wing	05/09/2001	07:46 PM	Tstm Wind	60 kts.	0	0	0	0
155 Frontenac	05/09/2001	08:23 PM	Hail	0.75 in.	0	0	0	0
156 Red Wing	06/11/2001	03:45 PM	Funnel Cloud	N/A	0	0	0	0
157 Goodhue	06/11/2001	05:45 PM	Hail	1.75 in.	0	0	0	0
158 Red Wing	06/11/2001	06:00 PM	Tstm Wind	52 kts.	0	0	0	0
159 Dennison	06/17/2001	06:20 PM	Hail	1.50 in.	0	0	0	0
160 Frontenac	06/17/2001	08:05 PM	Hail	1.50 in.	0	0	0	0

161 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/30/2001	09:00 AM	Excessive Heat	N/A	0	0	0	0
162 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	08/01/2001	12:00 AM	Excessive Heat	N/A	1	0	0	0
163 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	08/04/2001	12:00 PM	Excessive Heat	N/A	5	0	0	0
164 MNZ078 - 085 - 091>093	01/31/2002	12:00 PM	Winter Storm	N/A	0	0	0	0
165 MNZ078 - 085 - 091>093	02/01/2002	12:00 AM	Winter Storm	N/A	0	0	0	0
166 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	03/08/2002	06:00 PM	Winter Storm	N/A	0	0	0	0
167 MNZ042>045 - 048>070 - 073>078 - 082>085 - 091	03/14/2002	08:00 AM	Winter Storm	N/A	0	0	0	0

168 Stanton	05/08/2002	03:10 PM	Hail	1.00 in.	0	0	0	0
169 Wanamingo	05/08/2002	04:13 PM	Hail	0.75 in.	0	0	0	0
170 Goodhue	05/08/2002	04:30 PM	Hail	2.50 in.	0	0	0	0
171 Goodhue	05/08/2002	04:58 PM	Hail	1.75 in.	0	0	0	0
172 West Portion	06/21/2002	06:30 AM	Flash Flood	N/A	0	0	200K	0
173 Southeast Portion	06/21/2002	10:45 AM	Flash Flood	N/A	0	0	200K	0
174 MNZ078	06/21/2002	12:00 PM	Flood	N/A	0	0	100K	0
175 Stanton	07/28/2002	04:17 PM	Hail	1.00 in.	0	0	0	0
176 Cannon Falls	07/28/2002	04:50 PM	Hail	1.00 in.	0	0	0	0
177 Red Wing	07/28/2002	05:45 PM	Hail	1.00 in.	0	0	0	0
178 Kenyon	07/28/2002	06:00 PM	Tstm Wind	55 kts.	0	0	0	0
179 Zumbrota	07/28/2002	06:15 PM	Tstm Wind	52 kts.	0	0	0	0
180 Pine Is	07/28/2002	06:16 PM	Tstm Wind	52 kts.	0	0	0	0
181 Pine Is	07/30/2002	04:10 PM	Tstm Wind	52 kts.	0	0	0	0
182 Kenyon	08/16/2002	10:15 PM	Tstm Wind	52 kts.	0	0	0	0

183 Welch	08/16/2002	10:55 PM	Tstm Wind	52 kts.	0	0	0	0
184 MNZ053 - 060>063 - 065>070 - 073>078 - 083>085 - 091>093	12/09/2003	03:00 AM	Winter Storm	N/A	0	0	0	0
185 MNZ041>045 - 047>052 - 054>070 - 073>078 - 082>085 - 091>093	01/24/2004	09:00 PM	Winter Storm	N/A	0	0	0	0
186 MNZ044>045 - 051>052 - 059>063 - 065>070 - 073>078 - 082>085 - 091>093	02/01/2004	02:00 AM	Winter Storm	N/A	0	0	0	0
187 MNZ060 - 062>063 - 068>070 - 076>078 - 083>085 - 091>093	03/05/2004	12:00 AM	Winter Storm	N/A	0	0	0	0
188 MNZ053 - 060>063 - 067>070 - 073>078 -	04/18/2004	01:00 PM	High Wind	52 kts.	0	0	0	0

082>085 - 091>093								
189 Cannon Falls	04/18/2004	12:03 AM	Hail	1.00 in.	0	0	0	0
190 Red Wing	04/18/2004	12:30 AM	Hail	0.75 in.	0	0	0	0
191 Zumbrota	05/09/2004	08:45 PM	Hail	0.75 in.	0	0	0	0
192 Zumbrota	05/09/2004	08:57 PM	Hail	0.75 in.	0	0	0	0
193 Goodhue	05/30/2004	06:08 PM	Funnel Cloud	N/A	0	0	0	0
194 Zumbrota	05/30/2004	06:28 PM	Tornado	F0	0	0	0	0
195 Cannon Falls	06/23/2004	04:04 PM	Tstm Wind	55 kts.	0	0	10K	0
196 Dennison	06/23/2004	04:05 PM	Tstm Wind	52 kts.	0	0	0	0
197 Red Wing	06/23/2004	04:10 PM	Tstm Wind	59 kts.	0	0	0	0
198 Cannon Falls	06/23/2004	04:13 PM	Tstm Wind	54 kts.	0	0	0	0
199 Zumbrota	07/21/2004	01:20 AM	Tstm Wind	52 kts.	0	0	0	0
200 Welch	08/25/2004	05:34 PM	Hail	1.00 in.	0	0	0	0
201 MNZ078 - 084>085 - 091>093	09/14/2004	11:45 PM	Flood	N/A	0	0	6.7M	21.6M
202 MNZ066 -	09/15/2004	11:00 AM	Strong Wind	40	0	0	1K	0

070 - 078				kts.				
203 Stanton	10/29/2004	05:19 PM	Tstm Wind	55 kts.	0	0	0	0
204 Cannon Falls	10/29/2004	05:34 PM	Hail	1.00 in.	0	0	0	0
205 MNZ041>043 - 047>051 - 054>059 - 064>070 - 073>078 - 082>085 - 091>093	12/12/2004	06:00 AM	High Wind	40 kts.	0	0	0	0
206 MNZ044>045 - 049>070 - 073>078 - 082>085 - 091>093	01/01/2005	10:00 AM	Winter Storm	N/A	0	0	0	0
207 MNZ042>045 - 049>053 - 059>063 - 068>070 - 078	01/21/2005	10:00 AM	Winter Storm	N/A	0	0	0	0
208 MNZ070 - 077>078 - 085	02/19/2005	06:00 PM	Winter Storm	N/A	0	0	0	0
209 MNZ060 - 062>063 - 065>070 - 073>078 - 082>085 - 091>093	03/18/2005	12:00 AM	Winter Storm	N/A	0	0	0	0

210 Zumbrota	03/30/2005	02:40 PM	Hail	1.75 in.	0	0	0	0
211 Zumbrota	03/30/2005	03:15 PM	Funnel Cloud	N/A	0	0	0	0
212 Frontenac	03/30/2005	03:35 PM	Hail	1.00 in.	0	0	0	0
213 MNZ078	03/30/2005	05:00 PM	Flood	N/A	0	0	0	0
214 Cannon Falls	06/07/2005	04:05 PM	Hail	1.50 in.	0	0	0	0
215 Red Wing	06/07/2005	05:07 PM	Tstm Wind	50 kts.	0	0	0	0
216 Hader	06/07/2005	05:51 PM	Hail	1.00 in.	0	0	0	0
217 Countywide	06/07/2005	08:00 PM	Flash Flood	N/A	1	1	100K	0
218 Wanamingo	06/07/2005	08:55 PM	Hail	1.00 in.	0	0	0	0
219 Kenyon	06/07/2005	09:00 PM	Hail	1.25 in.	0	0	0	0
220 Kenyon	06/07/2005	09:00 PM	Tstm Wind	56 kts.	0	0	0	0
221 MNZ078	06/07/2005	11:15 PM	Flood	N/A	0	0	545K	0
222 Sogn	06/11/2005	11:50 AM	Tstm Wind	55 kts.	0	0	0	0
223 Cannon Falls	06/29/2005	09:35 PM	Tstm Wind	52 kts.	0	0	0	0
224 Kenyon	06/29/2005	09:35 PM	Tstm Wind	52 kts.	0	0	0	0
225 Red Wing	06/29/2005	10:00 PM	Tstm Wind	52 kts.	0	0	0	0

226 Countywide	07/17/2005	08:30 PM	Tstm Wind	50 kts.	0	0	0	0
227 Red Wing	08/09/2005	03:10 PM	Tstm Wind	52 kts.	0	0	0	0
228 Frontenac	08/09/2005	03:21 PM	Tstm Wind	52 kts.	0	0	0	0
229 MNZ049>050 - 052>053 - 059 - 063 - 066>070 - 076 - 078 - 083 - 085 - 092>093	12/13/2005	08:00 PM	Heavy Snow	N/A	0	0	0	0
230 MNZ078 - 085 - 092>093	02/15/2006	07:00 PM	Winter Storm	N/A	0	0	0	0
231 MNZ051>054 - 056>070 - 073>078 - 082>085 - 091>093	03/12/2006	12:00 PM	Winter Storm	N/A	0	0	0	0
232 MNZ051 - 059>063 - 068>070 - 078	03/15/2006	08:00 PM	Winter Storm	N/A	0	0	0	0
233 Hader	05/29/2006	03:25 PM	Hail	1.00 in.	0	0	0	0
234 Red Wing	05/29/2006	03:35 PM	Hail	0.75 in.	0	0	0	0
235 Wastedo	06/24/2006	04:20 PM	Hail	0.75 in.	0	0	0	0
236 Hader	06/24/2006	04:30 PM	Hail	0.75 in.	0	0	0	0

237 White Rock	06/24/2006	04:30 PM	Hail	1.00 in.	0	0	0	0
238 Goodhue	06/24/2006	04:40 PM	Hail	0.88 in.	0	0	0	0
239 Welch	06/24/2006	04:45 PM	Hail	0.88 in.	0	0	0	0
240 Red Wing	06/24/2006	04:55 PM	Hail	0.88 in.	0	0	0	0
241 Cannon Falls	07/19/2006	09:05 AM	Tstm Wind	52 kts.	0	0	0	0
242 Zumbrota	07/19/2006	09:12 AM	Tstm Wind	55 kts.	0	0	0	0
243 Goodhue	07/19/2006	09:20 AM	Tstm Wind	58 kts.	0	0	0	0
244 Zumbrota	07/19/2006	10:15 PM	Hail	0.75 in.	0	0	0	0
245 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091>093	07/30/2006	10:00 AM	Heat	N/A	0	0	0	0
246 Kenyon	08/24/2006	09:05 AM	Hail	0.88 in.	0	0	0	0
247 Dennison	08/24/2006	09:19 AM	Hail	0.75 in.	0	0	0	0
248 Zumbrota	08/24/2006	09:50 AM	Hail	0.75 in.	0	0	0	0
249 Wanamingo	08/24/2006	10:03 AM	Hail	1.75 in.	0	0	0	0

250 Stanton	08/24/2006	10:40 AM	Hail	1.75 in.	0	0	0	0
251 Kenyon	08/24/2006	10:50 AM	Hail	2.75 in.	0	0	0	5.0M
252 Wanamingo	08/24/2006	10:58 AM	Hail	1.75 in.	0	0	0	0
253 Zumbrota	08/24/2006	11:02 AM	Hail	1.00 in.	0	0	0	0
254 Zumbrota	08/24/2006	11:15 AM	Hail	1.00 in.	0	0	0	0
255 MNZ070 - 078	01/14/2007	16:00 PM	Heavy Snow	N/A	0	0	0K	0K
256 MNZ078	02/23/2007	22:30 PM	Winter Storm	N/A	0	0	0K	0K
257 MNZ041>045 - 047>070 - 073>078 - 082>085 - 091	03/01/2007	00:00 AM	Winter Storm	N/A	0	0	0K	0K
258 Hader	04/30/2007	13:22 PM	Hail	0.88 in.	0	0	0K	0K
259 MNZ063 - 078	05/06/2007	09:45 AM	High Wind	50 kts.	0	0	0K	0K
260 Dennison	05/23/2007	15:10 PM	Tornado	F0	0	0	0K	0K
261 Red Wing	06/21/2007	00:42 AM	Hail	1.00 in.	0	0	0K	0K
262 Red Wing	06/21/2007	01:00 AM	Hail	1.75 in.	0	0	0K	0K
263 Kenyon	07/03/2007	16:45 PM	Hail	0.75 in.	0	0	0K	0K

264 Kenyon	07/26/2007	18:00 PM	Thunderstorm Wind	52 kts.	0	0	0K	0K
265 Wanamingo	08/11/2007	03:38 AM	Thunderstorm Wind	50 kts.	0	0	0K	0K
266 Welch	08/11/2007	20:00 PM	Hail	1.75 in.	0	0	0K	0K
267 Kenyon	08/11/2007	20:12 PM	Hail	0.75 in.	0	0	0K	0K
268 Kenyon	08/11/2007	20:12 PM	Thunderstorm Wind	55 kts.	0	0	0K	0K
269 Stanton	08/18/2007	23:00 PM	Flash Flood	N/A	0	0	0K	0K
270 Cannon Falls	08/28/2007	11:25 AM	Hail	1.00 in.	0	0	0K	0K
271 Zumbrota	09/13/2007	11:37 AM	Hail	0.88 in.	0	0	0K	0K
272 MNZ053 - 060>063 - 066>070 - 073>078 - 082>083 - 085 - 091	11/19/2007	22:30 PM	Dense Fog	N/A	0	0	0K	0K
273 MNZ051 - 058>060 - 066>069 - 075 - 078	12/01/2007	09:00 AM	Winter Storm	N/A	0	0	0K	0K
274 MNZ078 - 085 - 093	01/29/2008	12:00 PM	Blizzard	N/A	0	0	0K	0K
275 MNZ041>045 - 047>070 -	02/10/2008	02:00 AM	Cold/wind Chill	N/A	0	0	0K	0K

073>078 - 082>085 - 091								
276 MNZ054>056 - 060 - 064 - 070 - 078	03/20/2008	20:00 PM	Winter Storm	N/A	0	0	0K	0K
277 MNZ078	03/31/2008	10:00 AM	Heavy Snow	N/A	0	0	0K	0K
278 MNZ044 - 049>053 - 058>063 - 066>070 - 076>078 - 084	04/01/2008	00:00 AM	Heavy Snow	N/A	0	0	0K	0K
279 Cannon Falls	05/31/2008	18:30 PM	Hail	1.00 in.	0	0	0K	0K
280 White Rock	05/31/2008	18:40 PM	Hail	1.25 in.	0	0	0K	0K
				TOTALS:	17	3	227.151M	26.600M

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Query Results

271 event(s) were reported in **Pierce County, Wisconsin** between **01/01/1950** and **05/31/2008 (High Wind limited to speed greater than 0 knots).**

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Wisconsin

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 PIERCE	05/10/1953	1830	Tornado	F2	0	0	2.5M	0
2 PIERCE	06/29/1954	1530	Tornado	F	0	0	3K	0
3 PIERCE	07/30/1954	1900	Tornado	F2	0	0	0K	0
4 PIERCE	07/22/1955	1400	Tornado	F	0	0	3K	0
5 PIERCE	05/24/1958	1445	Tornado	F3	0	0	250K	0
6 PIERCE	05/23/1964	1800	Hail	2.00 in.	0	0	0	0
7 PIERCE	07/15/1965	2000	Tornado	F1	0	0	0K	0
8 PIERCE	07/10/1966	2000	Tornado	F1	0	2	250K	0
9 PIERCE	07/22/1967	2130	Tornado	F2	0	3	250K	0
10 PIERCE	07/15/1969	2015	Tornado	F0	0	0	3K	0
11 PIERCE	07/18/1970	2100	Tornado	F0	0	0	25K	0
12 PIERCE	08/16/1973	1530	Hail	0.75 in.	0	0	0	0
13 PIERCE	09/10/1975	1835	Hail	1.75 in.	0	0	0	0
14 PIERCE	09/08/1977	2315	Tstm Wind	0 kts.	0	0	0	0
15 PIERCE	06/16/1979	1109	Tstm Wind	0 kts.	0	0	0	0
16 PIERCE	06/16/1979	1120	Tstm Wind	0 kts.	0	0	0	0
17 PIERCE	06/19/1979	2200	Tstm Wind	0 kts.	0	0	0	0
18 PIERCE	06/19/1979	2200	Tstm Wind	52 kts.	0	0	0	0
19 PIERCE	10/03/1979	1015	Tornado	F2	0	0	25K	0
20 PIERCE	07/11/1980	2040	Hail	3.00 in.	0	0	0	0
21 PIERCE	07/11/1980	2040	Tstm Wind	69 kts.	0	0	0	0
22 PIERCE	07/11/1980	2100	Tstm Wind	52 kts.	0	0	0	0
23 PIERCE	07/15/1980	1945	Tstm Wind	0 kts.	0	0	0	0
24 PIERCE	07/15/1980	2015	Hail	0.75 in.	0	0	0	0
25 PIERCE	06/14/1981	0555	Tornado	F2	0	0	250K	0

26 PIERCE	06/14/1981	0555	Tstm Wind	0 kts.	0	0	0	0
27 PIERCE	05/04/1982	1800	Tstm Wind	0 kts.	0	0	0	0
28 PIERCE	07/06/1982	0045	Tstm Wind	0 kts.	0	0	0	0
29 PIERCE	07/25/1982	1530	Tstm Wind	69 kts.	0	0	0	0
30 PIERCE	07/25/1982	1600	Tstm Wind	0 kts.	0	0	0	0
31 PIERCE	08/26/1982	1930	Tstm Wind	70 kts.	0	0	0	0
32 PIERCE	06/30/1983	1905	Tstm Wind	52 kts.	0	0	0	0
33 PIERCE	07/19/1983	1540	Tstm Wind	0 kts.	0	0	0	0
34 PIERCE	07/19/1983	1648	Tstm Wind	0 kts.	0	0	0	0
35 PIERCE	08/15/1983	1605	Hail	1.75 in.	0	0	0	0
36 PIERCE	08/15/1983	1605	Tstm Wind	0 kts.	0	0	0	0
37 PIERCE	08/16/1983	1605	Tstm Wind	0 kts.	0	0	0	0
38 PIERCE	06/07/1984	2014	Tstm Wind	0 kts.	0	0	0	0
39 PIERCE	10/16/1984	1935	Tstm Wind	0 kts.	0	0	0	0
40 PIERCE	05/11/1985	1810	Tstm Wind	61 kts.	0	0	0	0
41 PIERCE	05/30/1985	1640	Hail	1.75 in.	0	0	0	0
42 PIERCE	07/24/1986	1620	Tstm Wind	0 kts.	0	0	0	0
43 PIERCE	07/27/1986	0410	Tstm Wind	0 kts.	0	0	0	0
44 PIERCE	07/27/1986	0420	Tstm Wind	0 kts.	0	0	0	0
45 PIERCE	06/28/1987	1635	Hail	1.00 in.	0	0	0	0
46 PIERCE	06/28/1987	1635	Tstm Wind	52 kts.	0	0	0	0
47 PIERCE	06/28/1987	1700	Tstm Wind	52 kts.	0	0	0	0
48 PIERCE	06/28/1987	1730	Tstm Wind	52 kts.	0	0	0	0
49 PIERCE	07/20/1987	2000	Tstm Wind	0 kts.	0	0	0	0

50 PIERCE	07/27/1987	0230	Tstm Wind	61 kts.	0	0	0	0
51 PIERCE	06/19/1988	1815	Hail	1.50 in.	0	0	0	0
52 PIERCE	08/07/1988	1835	Tstm Wind	0 kts.	0	0	0	0
53 PIERCE	08/07/1988	1850	Tstm Wind	0 kts.	0	0	0	0
54 PIERCE	05/23/1989	1817	Hail	0.75 in.	0	0	0	0
55 PIERCE	05/29/1989	1357	Hail	0.75 in.	0	0	0	0
56 PIERCE	05/29/1989	1400	Hail	0.75 in.	0	0	0	0
57 PIERCE	08/13/1989	2048	Tstm Wind	0 kts.	0	0	0	0
58 PIERCE	04/23/1990	0120	Hail	1.00 in.	0	0	0	0
59 PIERCE	06/12/1990	1725	Hail	0.75 in.	0	0	0	0
60 PIERCE	06/12/1990	1735	Tornado	F1	0	1	250K	0
61 PIERCE	06/12/1990	1735	Tstm Wind	52 kts.	0	0	0	0
62 PIERCE	06/12/1990	1745	Tstm Wind	0 kts.	0	0	0	0
63 PIERCE	08/26/1990	0400	Tstm Wind	0 kts.	0	0	0	0
64 PIERCE	09/09/1990	1710	Hail	1.75 in.	0	0	0	0
65 PIERCE	09/09/1990	1730	Hail	2.75 in.	0	0	0	0
66 PIERCE	09/09/1990	1828	Tstm Wind	0 kts.	0	0	0	0
67 PIERCE	05/27/1991	1400	Hail	1.00 in.	0	0	0	0
68 PIERCE	05/28/1991	2245	Tstm Wind	0 kts.	0	0	0	0
69 PIERCE	05/28/1991	2300	Tstm Wind	0 kts.	0	0	0	0
70 PIERCE	06/17/1992	0035	Hail	1.75 in.	0	0	0	0
71 Statewide	01/13/1993	0000	Heavy Snow	N/A	0	0	0	0
72 Central And Southern	01/05/1994	1200	Heavy Snow	N/A	0	0	0	0

73 Statewide	01/13/1994	0600	Cold	N/A	0	0	0	0
74 All But Far Northwest	01/26/1994	2000	Heavy Snow/ice Storm	N/A	0	0	0	0
75 Statewide	04/23/1994	1200	Wildfires	N/A	0	0	500K	500K
76 Trimbelle	04/26/1994	1100	Hail	1.25 in.	0	0	0	0
77 Ellsworth	04/26/1994	1101	Hail	1.25 in.	0	0	0	0
78 Beldenville	04/26/1994	1105	Hail	1.25 in.	0	0	0	0
79 River Falls	05/30/1994	1540	Thunderstorm Winds	0 kts.	0	0	1K	1K
80 Statewide	06/14/1994	1200	Heat Wave	N/A	0	0	0	0
81 Prescott	07/05/1994	0430	Hail	1.00 in.	0	0	0	0
82 WIZ001>021 - 023>033 - 035	11/27/1994	0900	Heavy Snow	N/A	0	0	0	0
83 Northern	02/10/1995	2100	Cold	N/A	0	0	0	0
84 WIZ024>026 - 028	03/06/1995	0000	Heavy Snow	N/A	0	0	0	0
85 WIZ001>074	06/17/1995	1300	Extreme Heat	N/A	9	0	0	0
86 WIZ005>072	07/13/1995	0800	Extreme Heat	N/A	57	0	0	0
87 Maiden Rock	07/14/1995	1740	Hail	0.88 in.	0	0	0	0
88 Maiden Rock	07/14/1995	1740	Hail	0.88 in.	0	0	0	0
89 Prescott	07/27/1995	1705	Lightning	N/A	0	0	15K	0
90 Prescott	07/27/1995	1705	Lightning	N/A	0	0	15K	0
91 Portions Of West Cent	08/11/1995	0800	Heavy Rain	N/A	0	0	0	0
92 Portions Of West Cent	08/11/1995	0800	Heavy Rain	N/A	0	0	0	0
93 Statewide	10/12/1995	1400	Record Warmth	N/A	0	0	0	0
94 West Central	11/26/1995	2000	Heavy Snow	N/A	0	0	0	0
95 West Central Wi	12/06/1995	2000	Heavy Snow	N/A	0	0	0	0
96 WIZ023>028	12/13/1995	0600	Glaze	N/A	0	0	0	0

97 WIZ014>016 - 023>028	01/17/1996	09:00 PM	Ice Storm	N/A	0	0	0	0
98 WIZ014>016 - 023>028	01/18/1996	05:00 AM	Heavy Snow	N/A	0	0	0	0
99 WIZ015>016 - 024>028	01/26/1996	02:00 PM	Blizzard	N/A	1	0	0	0
100 WIZ024>028	01/29/1996	05:00 AM	Blizzard	N/A	0	0	0	0
101 WIZ014>016 - 023>028	01/31/1996	05:00 AM	Extreme Cold	N/A	0	0	0	0
102 WIZ014>016 - 023>028	02/01/1996	12:00 AM	Extreme Cold	N/A	1	0	0	0
103 WIZ014>016 - 023>028	02/08/1996	12:00 AM	Freezing Rain	N/A	0	0	0	0
104 WIZ014>016 - 023>028	03/24/1996	01:00 AM	Heavy Snow	N/A	0	0	0	0
105 River Falls	05/19/1996	01:00 AM	Tstm Wind	75 kts.	0	0	1.0M	0
106 Ellsworth	06/26/1996	12:26 PM	Hail	0.75 in.	0	0	0	0
107 Elmwood	06/26/1996	12:36 PM	Hail	0.75 in.	0	0	0	0
108 Hager City	06/29/1996	01:40 PM	Hail	0.75 in.	0	0	0	0
109 Hager City	06/29/1996	01:40 PM	Tstm Wind	70 kts.	0	0	3.5M	0
110 Bay City	06/29/1996	01:45 PM	Hail	0.75 in.	0	0	0	0
111 River Falls	10/16/1996	06:30 PM	Hail	0.88 in.	0	0	0	0
112 River Falls	10/16/1996	07:00 PM	Hail	0.75 in.	0	0	0	0
113 River Falls	10/16/1996	07:00 PM	Lightning	N/A	0	0	0	0
114 WIZ023>024 - 026	10/29/1996	11:00 PM	High Wind	50 kts.	0	0	0	0
115 WIZ023>028	11/15/1996	01:00 AM	Ice Storm	N/A	0	0	0	0
116 WIZ024>026 - 028	11/20/1996	06:00 AM	Heavy Snow	N/A	0	0	0	0

117 WIZ014>016 - 023>028	11/23/1996	12:00 AM	Heavy Snow	N/A	0	0	0	0
118 WIZ014>016 - 023>027	12/14/1996	04:00 PM	Heavy Snow	N/A	0	0		

Guidelines for Operating an Interim On Site Low Level Radioactive Waste Storage Facility

Public Version

Final Draft February 12, 2008

EPRI Project Manager
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CONTENTS

1
INTRODUCTION

The majority of commercial USA nuclear stations have constructed on-site LLW storage facilities, and most of these same utilities have experienced at least one short period of interim on-site storage. These *Guidelines* focus on operational considerations and incorporate many of the lessons learned while operating various types of LLW storage facilities.

1.1 Purpose

This report provides general guidelines for the safe, efficient, and routine operation of an on-site LLW storage facility. It is anticipated that the user of this report will refer to it throughout the development and implementation of the storage program to ensure that major program components are being addressed and are being performed in a timely manner. It is further anticipated that the user will continue to refer to and utilize this report and the related EPRI storage reports as part of the routine operation of the storage facility.

1.2 Definitions

The regulatory guidance in this *Guidelines* document is derived from USA regulations. However, the guidance is applicable to all LLW storage facilities operated by domestic and international members of EPRI's Nuclear Business Group. The following definitions clarify key terms which may not have a common meaning to the international community.

- Low level radioactive waste (LLW) is a general term for a wide variety of radioactively contaminated wastes. These wastes include protective clothing, machinery and related components, processed solids, and other substances that have been contaminated with varying levels of radioactivity. Various countries subdivide LLW into other categories, such as medium level waste and intermediate level waste. The USA subdivides LLW by "waste Class," including Class A, Class B, Class C, and Greater Than Class C (GTCC) wastes. For the purpose of these *Guidelines*, unless otherwise specified, the term LLW encompasses all of these international and domestic subcategories.

- Dry Solid LLW is solid radioactive waste which was not generated as a result of liquid treatment processes. This includes combustible solids, compactable solids, metal, plastics, concrete, and similar dry wastes.

- Wet Solid LLW is any radioactive waste arising from liquid treatment processes (e.g., spent ion exchange resin, spent cartridge filters, evaporator concentrates, sludge). In some countries, this is also simply called "wet wastes." Prior to shipment for disposal, wet solid waste may be further processed to ensure that there are no free liquids, therefore meeting the waste acceptance criteria for disposal.

- Liquid LLW is defined as low level radioactive liquid (e.g., oil, decontamination solutions, aqueous liquids). For interim storage considerations, liquid waste is further defined as any waste that contains free liquid in amounts which exceed the requirements for disposal as established by the disposal facility licensing authority.

- Solidified LLW for storage purposes is liquid waste or wet solid waste that has been converted into a solid waste form to meet the waste acceptance criteria for disposal.

- Waste Container means any container used to collect and store LLW. The waste container may or may not be the transport waste package. If and when a waste generator determines that a waste container is the transport waste package, only at that time is the waste generator required to comply with the transport package regulations in 49CFR.

- Waste Package means a packaging plus its contents as used for transport. Packaging means a receptacle and any other components or materials necessary for the receptacle to perform its containment function. [64]. It should be noted that the contents of a transport waste package may be a waste container.

- Waste Storage Module or Storage Shield refers to a movable concrete assembly which provides safe interim storage for a waste container, including protection from adverse environmental conditions and inadvertent intruder access, as well as providing shielding to reduce radiation dose rates to personnel, surrounding area, and site boundary. For the purposes of this Guidelines document, a waste storage module or shield may contain or store a waste container or waste package, but it is not in itself a waste container or waste package. A waste storage module or shield with stored radioactive contents must be located within a licensed area, although it may be located within another structure or facility, or it may be located on a utility approved outside interim storage pad.

1.3 Storage of Hazardous Waste and Mixed Waste

Storage of hazardous waste, as specified under the Resource Conservation and Recovery Act (RCRA), is not addressed in this *Guidelines* document. Some plants will need to store LLW that also contains hazardous wastes. These mixed wastes are regulated both by the US Nuclear Regulatory Commission (USNRC) (for the radioactive component of the waste) and by the US Environmental Protection Agency (USEPA) (for the hazardous component of the waste). The guidance provided in this *Guidelines* document applies only to the materials being stored in accordance with USNRC regulations.

1.4 Clarification of the Term "Interim Storage"

This document is specifically intended for management of radioactive waste that is ultimately destined for final disposal. I t is not intended to be used for control of radioactive material (RAM) that is temporarily stored or staged for reuse. It also does not address storage of partially full containers that are "in-service. The term "interim storage," as used throughout this report, refers to storage within existing or planned interim on-site LLW facilities. **As used herein, interim storage refers to a long term perspective (i.e., years) as opposed to small, "buffer storage" facilities provided for routine plant operation, even though both may be similar in design.** It is important to note that most buffer

storage facilities were not constructed for LLW interim storage. Instead, most buffer storage facilities were originally designed as holding or staging areas pending one of the following situations:

(1) Awaiting the accumulation of a sufficient number of LLW packages to constitute a full shipment.

(2) Awaiting laboratory analyses for packaged LLW. Such analyses are necessary to complete waste classification and shipping document preparation.

(3) Awaiting relief from temporary suspended access to existing disposal sites.

(4) Awaiting availability of a special transport package or vehicle.

(5) Awaiting approval from a disposal site to initiate a shipment pursuant to the advance notification requirements of the NRC, a particular state, compact authority, etc.

(6) Awaiting approval from the regulator, disposal site, or other agency or consignee to ship the waste in a specific container, waste form, or package.

(7) Holding LLW for decay of very short-lived radionuclides.

(8) Awaiting the initial operation of a new processing facility or processing capacity (e.g., the plant may be waiting in line pending a backlog of waste at the waste processing facility).

These clarifications are significant to several utilities operating under specific licensing or other legal/contractual limitations related to on-site storage. Hence, for the purposes of this document, the term "interim storage" is intended to mean interim retention of radioactive waste until a final disposal option becomes available.

1.5 Organization of This Report

The remainder of this report provides three types of "guidance:"

1. **Regulatory Guidance** – This is guidance which is derived from regulatory sources, including regulations, USNRC Information Notices, USNRC Generic Letters, and similar documents. This guidance is closely aligned with the exact wording from the referenced documents. For easy identification, regulatory guidance is shown in italics and has a heavy vertical bar to the left of the paragraph, as illustrated by the bar to the left of this paragraph.

2. **EPRI/Industry Guidance** – This is guidance derived from existing EPRI interim storage publications, American Nuclear Insurers storage guidance, industry experience and lessons learned, and other non-regulatory sources. In addition, a review of USNRC Inspection Manuals and Procedures related to interim storage suggested a need for developing and including some additional guidance not specifically included in nor quoted from regulations or regulatory guidance documents (i.e., not verbatim regulatory guidance).

3. **Recommendations** – There are relatively few recommendations, as compared to other guidance items. In general, a plant electing to operate an interim storage facility in accordance with this

Guidelines document would normally adhere to Regulatory Guidance and EPRI/Industry Guidance and develop and document specific justification for any deviations. In contrast, the interim LLW storage facility operator is not required to implement any recommendations and is not required to develop or document any specific justification for ignoring such recommendations. For easy identification, recommendations are clearly identified with the word **RECOMMENDATION** capitalized and in bold at the beginning of the paragraph.

This document also is extensively referenced using the symbol [x], where x is the number of the reference in Appendix A. In some cases, multiple references are enclosed in brackets, [x,y,z]. If a multiple reference includes Regulatory Guidance, then the Regulatory Guidance is also annotated as described above.

1.6 Time Value of the Technical Data

As with all technical information, the regulatory requirements, disposal site criteria, and state-of-the-art practices will change over time. Every effort has been made to ensure that all technical data, regulatory requirements, disposal site criteria, etc., are current at the time of publication. It is incumbent upon the user of this report to remain current with advancements in LLW technology, particularly with regard to on-site storage requirements and disposal site waste acceptance criteria for their state/regional compact.

2
GUIDANCE ON STORAGE FACILITY START-UP EVALUATION

This *Guidelines* document focuses on operating an interim low level waste (LLW) storage facility as opposed to the design and construction of the facility. However, operation includes start-up evaluations of certain design features, such as the proper operation of fire suppression systems, floor drains, ventilation, etc. Similarly, during the plant life cycle, new interim storage facilities may be added, existing facilities may be expanded, or significant design modifications may be made. Each of these evolutions would be followed by a start-up evaluation.

This Chapter identifies key storage facility and program features which should be evaluated prior to storing LLW in a new, expanded, or otherwise modified on-site storage facility.
RECOMMENDATION: It is recommended that a similar evaluation be performed:

- Prior to storing waste in a facility which has not previously stored waste of this type, form, activity, and high dose rate?
- Prior to storing waste in a facility which was not originally designed for such waste.
- Upon initial publication of this *Guidelines* document to ensure that no significant item has been previously overlooked in the on-site storage program.

RECOMMENDATION: Although not a requirement, it is recommended that a periodic comprehensive review be performed of the storage facility and all storage activities, records, procedures, etc. Ideally, this should be performed by an outside organization or as a peer review by another utility.

2.1 Licensing, Safety Analysis Report, and Other Regulatory Requirements for Start-up

2.1.1 Previous USNRC Guidance Replaced or Deleted

Most storage facilities at USA commercial nuclear plants were constructed prior to 1994. In August 1994, the USNRC released a draft of SECY-94-198, *Review of Existing Guidance Concerning the Extended Storage of Low-Level Radioactive Waste* [1]. Although it was not officially signed and issued by the Commission, SECY 94-198 appeared to replace SECY 93-323 [63]. SECY-94-198 also combined, revised, and superseded the guidance in the following USNRC reference documents: SECY-90-318 [60], Generic Letter GL-81-38 [33], Information Notice IN-90-09 [36], Information Notice IN-89-13 [35], and Generic Letter GL-85-14 [31]. Those were primary reference documents used in the design and construction of LLW storage facilities, and some revised or deleted key passages from those documents may appear in plant procedures, license technical specifications, or the Safety Analysis

Report (SAR). Note that throughout this Guidelines document, wherever reference [1] is specified, it refers to SECY-94-198 and the references included in SECY-94-198, which are [31, 33, 35, 36].

The operator of a storage facility should review procedures, technical specifications, and the SAR to determine if any of the following considerations need to be addressed:

- References to GL-81-38, IN-90-09, IN-89-13, and GL-85-14 appeared to be superseded by SECY-94-198. However, SECY-94-198 was never formally issued by the Commission.

- SECY-94-198 states: *The USNRC staff has eliminated any language relative to the above documents that implies a 5-year "limit," beyond which storage would not be allowed, or which imposes any special review requirements. [1]* Since SECY-94-198 was never formally issued, the 5-year limit was not eliminated. However, NUREG 0800 Revision 3 - March 2007, section 11.4 SOLID WASTE MANAGEMENT SYSTEM, as referenced by the NRC at a public meeting on waste storage conducted on January 30, 2008, states: "It should be noted that under SECY 94-198 and SECY 93-323, the provision requiring a Part 30 license for the storage of waste beyond 5 years has been eliminated".
  - Further, the NRC recognizes the practicality that some licensees may be forced to store LLW in excess of five years while awaiting approval, construction and licensing of a suitable LLW repository.
  - *Planning for interim waste storage should be for a period of time based on the status of the licensee's State or regional compact disposal facility program. [1]*

    Planning for the term of waste storage is a critical consideration. Storage of less than five years may have a very different impact on waste containers and waste forms than storage for more than 15 years. However, for some disposal facilities and waste classifications, storage may be for an extended period and should be carefully considered in all aspects of the LLW storage plan.

- *The previous requirement for power reactor licensees to obtain a separate Part 30 license for storage facilities located within a Part 50 licensed area has been deleted. [1]*
  - *However, if a licensee terminates its Part 50 license pursuant to decommissioning, then a Part 30, Part 70, or Part 72 license will be required to store any remaining byproduct material, special nuclear material, or Greater Than Class C (GTCC) waste, respectively. [1]*
  - *Commercial storage of LLW generated by "other licensees" on the reactor site will still require a separate Part 30 license for the operation of that facility. [1]*

  Note: Nuclear Regulatory Commission jurisdiction over storage of LLW generated and stored on-site will be retained in Agreement States in accordance with 10 CFR 150.15(a)(1). Indemnity coverage will be provided under and in accordance with your existing indemnity agreement with the Commission. [1] (See Chapter 7 for additional guidance for GTCC waste storage.)

- *10 CFR Part 50.59 evaluations are normally required when new LLW storage facilities are constructed. A §50.59 evaluation is also required for certain changes to existing facilities, including increases in total stored waste volumes and activities beyond those previously evaluated and included in the SAR. [1]* Utilities may wish to refer to NEI-96-07, Rev. 1 (2000), with regard to 50.59 reviews. [65]

- *In instances where no changes in the facility or procedures as described in the safety analysis report are involved in the storage of LLW, then a §50.59 evaluation would not be required. [1]*

- *Waste no longer is required to be processed before storage nor packaged in a form ready for transport and disposal at the end of the storage period. The intent of that previous guidance was to ensure that waste could be stored in a stable form and to eliminate double handling of the LLW, and the resultant increase in radiation exposures, from processing waste into one form for storage and then into another for disposal. [1]* This is addressed further in Chapter 5, Guidance on Waste Forms for Extended Storage.

- *Each license issued under 10CFR50 authorizing the possession of byproduct and special nuclear material produced in the operation of the licensed reactor includes, whether stated in the license or not, the authorization to receive back that same material, in the same or altered form or combined with byproduct or special nuclear material produced in the operation of another reactor of the same licensee located at that site, from a licensee of the Commission or an Agreement State, or from a non-licensed entity authorized to possess the material. [1]* This is specified in 10CFR50.54(ee)(1).

2.1.2 Adding Storage Capacity or Storage Facilities

For proposed increases in storage capacity for LLW generated by normal reactor operation and maintenance, the safety of the proposal must be evaluated. Generally, Part 50 licensees are already authorized under 10 CFR Part 30 to possess byproduct materials produced by the operation of their facility, within the limits of their operating license, and they will have described storage of LLW in their SAR. [1] (Some plants may also have storage specifications and limitations in their Technical Specifications.)

General Guidance for Adding Storage Capacity

To increase storage capacities authorized in the SAR, or to construct new storage facilities, perform an evaluation of the safety of LLW storage, document that evaluation, and make it available for USNRC staff inspections. (See Chapter 7 for additional guidance for GTCC waste storage.) *Then either: [1]*

1. *amend your licenses where necessary to allow storage of LLW;*
2. *perform a §50.59 evaluation, document the evaluation, and report it to the Commission annually; or*
3. *conduct an evaluation under §20.1501 and maintain a record of the results in accordance with §20.2103(a).*

It also is possible to store waste from one nuclear plant at another nuclear plant, as has been accomplished by at least one USA nuclear utility. This requires a license amendment, which will specify the storage capacities and other limitations. This is discussed further in the following paragraphs. (Note that local restrictions or state laws may prohibit this capability.)

Specific Guidance for Adding Storage Capacity

- Begin your evaluation with a review of the technical specifications, SAR, and any USNRC correspondence related to on-site storage. Identify any special authorizations and requirements for LLW storage. [2] Note storage limitations with regard to:
  - Stored waste types, containers, and waste forms.
  - Stored radionuclides and activity limits, including license possession limits (e.g., Part 30 or Part 70 license). [2]
  - Physical and chemical form of the stored waste.
  - Stored waste classifications (e.g., GTCC waste stored in an ISFSI).
  - Limitations on stored volumes of each waste type.
  - Limitations on dose rates (package dose rates and facility exterior dose rates).
  - Any special storage considerations or restrictions.

- *In cases where no changes in the facility or procedures, as described in the SAR, are involved for storage of LLW, prepare safety evaluations of such storage in accordance with 10 CFR 20.1501. [1]*

- *In cases where the provisions of 10 CFR 50.59 apply, you may provide the added capacity, document the §50.59 evaluation, and report it to the Commission annually or as specified in the license. [1]*

  Note: *When §50.59 evaluations are required, Inspection and Enforcement Circular No. 80-18, dated August 22, 1980 [10], provides information on preparing §50.59 evaluations for changes to radioactive waste treatment systems, including those located in LLW storage facilities. [1]*

- *If you determine that an unreviewed safety question exists, or that a change in the technical specifications is required, as specified in §50.59, or that an existing license condition needs to be changed to accommodate LLW storage: [1]*
  - *Authority for storage should be requested through application for an amendment to your §50 license to the Office of Nuclear Reactor Regulation (NRR), accompanied by an environmental evaluation that considers the incremental impact as related to reactor operations. [1]*
  - *Application should also be accompanied by a showing that the storage provisions will not impact on the safety of reactor operations and will not foreclose alternatives for disposal of the wastes. [1]*

- *Maintain a record of the results of start-up evaluations in accordance with 10 CFR 20.2103(a). [1]*

Multi-Station Interim Storage Facility Authorization

One USA nuclear utility which owns multiple nuclear stations applied for and received approval to ship LLW generated at one station for interim storage at a second station within the same utility. This required a license amendment for the receiving station. The station offered the following insights as possible guidance for other utilities considering such a license amendment:

- An environmental impact analysis was required as part of the license amendment submission package. The NRC allowed the station to reference the existing environmental impact report developed for plant operation.
- The amendment request has to be noticed in the federal register for 30 days as part of the review and approval process.
- The amendment submission documents must clearly state that the new storage approach will not create an unfunded liability.
- The time from submission to approval of the amendment was approximately seven months.
- No reference was made to any storage term either as part of the amendment request or the final amendment.

2.2 Practical Storage Facility Start-up Evaluations

Prior to storing LLW, an overall evaluation of the interim storage facility should be performed to ensure that all facility features function correctly, identify any potential operating concerns and limitations, and capture baseline data. If this evaluation is being performed concurrent with LLW being moved into the facility, then it also starts the clock for subsequent inspections, surveillances, and monitoring.

- Start-up evaluations should be performed by individuals trained in accordance with:
  - USNRC IE Bulletin No. 79-19, "Packaging of Low Level Radioactive Waste for Transport and Burial." [4,11]
  - USNRC requirements related to handling, packaging and storage of Radioactive Material Quantities of Concern (RAMQC). [59]
  - USDOT regulations in 49 CFR 172 Subpart I related to (1) transportation Security Awareness training, and (2) Transportation Security Plan training.
  - Other USDOT hazmat training requirements, as applicable.

2.2.1 Start-up Review of Physical Facility Design Features

- *Verify personnel training and administrative procedures have been established to ensure both control of radioactive materials and minimum personnel exposures. [1]*
- On-site storage facilities should be located inside a fenced security area. [4]
  - They should not be located close to the site boundaries (fence line exposure issues, potential offsite releases) or in areas that are susceptible to flooding. [4]
  - Note that the recommendation for a fenced security area is an ANI rate-setting technical consideration which might be satisfied by other physical access restrictions. The NRC does not require a fenced security area for all stored waste, although reasonable physical security measures are required. The extent of the security measures will be plant-specific, locally determined, and must be appropriate to the type of materials stored (e.g., extensive physical controls are required for Radioactive Material Quantities of Concern, whereas less stringent controls are required for very low activity wastes).

- On-site storage facilities (buildings) should be provided with fire/smoke detectors and a suitable fire suppression system. [4]
  - Alarm systems should be monitored in a constantly manned location, such as the control room or guard station. [4]
  - The fire/smoke detectors should be periodically tested. [4]
  - If a liquid suppression system is used, provisions should be made to contain the fire suppression liquids (e.g., curbs, drains, collection tank, etc.). [4]
  - *Fire suppression devices may not be necessary if combustible materials are minimal in the area. [1]*
  - If gaseous suppression systems (e.g., CO_2) are used, the system should be provided with an interlock to warn of an automatic discharge when people are present in the building.

    For example, storage buildings at Ontario Power Generation are equipped with a CO_2 deluge system that is interlocked with the building lights. It can only be initiated by manual local action and only if the lights are turned off. This procedure requires that when an alarm is received, a person checks the building to ensure that no one is present, turns off the lights, then initiates the system. If the system were to initiate automatically when someone was in the building, they would be asphyxiated. It also provides local confirmation that the alarm is real before the system is activated. This is not the standard for most plants.

- *Confirm that provisions are incorporated for collecting liquid drainage, including provisions for sampling all collected liquids. [1,4]*
  - *Routing of the collected liquids should be to radwaste systems if contamination is detected or to normal discharge pathways if the water ingress is from external sources and remains uncontaminated. [1]*
  - In general, it is considered that the above requirements refer to an enclosed building, or that the outside storage module is designed and capable of collecting any liquid that escapes the waste container inside the storage module or other outside storage container.
  - The collection system should be sized such that no leakage can escape the facility. [4]
  - The collection system should contain leak detection capabilities (i.e., sump high level alarms). [4]
  - Alarm systems should be monitored in a constantly manned location such as the control room or guard station. [4]
  - The alarm system should be on a routine maintenance and surveillance schedule. [4]

RECOMMENDATIONS: In general, the use of electronic leak detection systems should be avoided for several reasons:

- During the design and construction phase, the collection system should be sized based on the largest amount of liquid that could enter the facility (most likely the fire suppression system, if applicable). If a fire occurred, a central alarm station should be notified.

- The building should be inspected such that other water intrusions are identified (e.g., leaking water under doors) and repaired.

- The sump should be inspected periodically and kept dry. Therefore, anytime liquid is discovered in the sump, it should immediately be sampled, analyzed and processed or released, as appropriate.

- It should be recognized that the probability of something happening that will trip a high level alarm for a properly sized sump is almost zero; moreover, the dependability of an infrequently used high level alarm or an electronic leak detection system will degrade quickly.

• *Confirm that provisions have been established for reprocessing and repackaging of stored wastes. [1]* This may include shipping to an offsite vendor for reprocessing/repackaging.

• *Any storage plans should address any potential reprocessing requirements for eventual shipment and burial. [1]*

• *Procedures should require waste stored in outside areas to be held securely by installed hold-down systems. [1]*

- *The hold-down system should secure all containers during severe environmental conditions up to, and including, the design basis event for this waste storage facility. [1]*
- Ensure that any required hold down capabilities are available and are serviceable.
- An example of a severe environmental condition was a hurricane that moved a full, improperly secured cargo container to another location on site.
- With regard to on-site storage modules, such as circular storage shields for liners and high integrity containers, most are quite heavy; however, they range from 14,000 lbs to just over 100,000 lbs; some rectangular storage modules weigh as little as 9,000 lbs. Design basis meteorological events may include tornadoes in excess of 300 mph, underscoring the need to secure the lighter containers.
- For any on-site storage shield, consideration should be given to securing the lid (top). Although lids can weigh up to 20,000 lbs, they can be displaced by a design-basis tornado, thereby exposing the stored waste container(s). Subsequent suction by the tornado could lift the stored waste containers from the storage module, turning them into missiles. For this reason, the majority of storage shield designs include a means of securing the lid to the sides of the storage module.
- The above considerations should be addressed as part of the safety analysis (e.g., 50.59 review) for on-site storage modules and other outside storage containers.

• Confirm that all containers, including empty containers, are protected from reasonably expected severe environmental conditions, including fire and flooding. [2]

• If outdoor storage is necessary, the pad should be adequately bermed to allow for the collection of rainwater and/or leakage from the stored containers. [4]

- The operative word here is "should." This should be addressed—either require berms or justify deletion—as part of the safety analysis (e.g., 50.59 review) related to control of leakage for on-site storage pads.

- *External weather protection should be included where necessary and practical to ensure container integrity against corrosion from the external environment. [1]*
  - In cold climates, protection may be required from freezing for wet solid wastes (resin, filters, concentrates).
  - The impact of freeze-thaw cycles on concrete containers, modules, and structures also needs to be evaluated (e.g., small cracks or cavities could accumulate water which will cause further damage during freeze/thaw cycles).

- *Procedures should require storage containers to be raised off storage pads, where water accumulation can be expected to cause external corrosion and possible degradation of container integrity. [1]* Ensure that this capability exists before attempting to place waste on the outside storage pad. Note that "storage container" in this statement refers to the "waste container" and not a storage shield or storage module.

- Efforts should be made to locate LLW storage facilities so as to reduce extremes of temperature or humidity (e.g., do not locate near a boiler room, laundry area, etc.). [2]

- Confirm that any required checks of fire protection systems have been performed (i.e., ensure that the fire suppression system is functioning properly). [2]

- Confirm that ventilation systems are installed as necessary and are functioning properly. [2]

- *Prior to start-up, ensure that procedures have been (1) written, (2) approved by management, and (3) are available to storage facility workers for the following: [1,2]*
  - Safe placement, inspection, and repackaging of LLW in storage. [2]
  - *Periodic testing of fire and smoke detectors. [1,4]*
  - Periodic testing of liquid collection system alarms. [4]
  - Periodic testing of any installed security alarms.
  - Continuously manned monitoring and response to fire, smoke, security, and liquid collection system alarms. [4] (See note in paragraph 3.2.1 regarding electronic leak detection systems and alarms.)
  - A routine maintenance and surveillance schedule for all fire, smoke, security, and liquid collection alarm systems. [4] (See note in paragraph 3.2.1 regarding electronic leak detection systems and alarms.)
  - Periodic inspection should be performed of the facility physical parameters, such as the full function of doors, latches and locks, berms, etc. This is especially important in areas that are shared with other plant functions.
  - *The results of all testing, surveillances, and maintenance must be documented and available for review. [1,2]*

2.2.2 Radiation Surveys, Monitoring, and Limitations

For any LLW storage facility, the allowable quantity of radioactive material is dictated, in part, by the dose rate criteria for both the site boundary and unrestricted areas on-site: [1] (This is, of course, in addition to any licensing conditions and any physical design restrictions.)

- Dose rates within and around the LLW storage facility must be monitored routinely.
  - Surveys should be performed and documented just prior to start-up to develop baseline data for the restricted area boundary and for the site boundary. This starts the clock for subsequent surveys and monitoring.
  - An ALARA (as low as reasonably achievable) plan should be developed which describes the location of high and low dose rate packages, portable shielding, and the use of low dose rate packages to shield higher dose rate packages. Skyshine must be considered. The ALARA plan should seek to minimize exposure to (1) workers, (2) storage facility exterior, (3) restricted area boundary, and (4) site boundary.

- *On-site dose associated with interim storage will be controlled per 10 CFR Part 20, including the ALARA principle of 10 CFR 20.1101. [1]*
- *10 CFR 20.1301 limits the exposure rates in unrestricted areas. [1]*
- *The 40 CFR Part 190 limits restrict the annual dose from direct radiation and effluent releases from all sources. [1]*
  - *Off-site doses from on-site storage must be sufficiently low to account for other sources (e.g., an additional dose of < 1 mrem/year contributed by stored waste is not likely to cause the limits of Part 190 to be exceeded). [1]*
- Inspect the storage area(s) to assure adequacy with respect to all radiological posting and waste container labeling requirements. [2]
- *Total activity limits should be established and known to the storage facility operators. [1]*
  - Waste management strategies should be based on the results of the 50.59 evaluation of onsite storage relative to existing FSAR accident scenarios, such as a fuel handling accident. Determination of the requirements for the storage facility and stored wastes should envelope the potential radiological impact of storage operations, e.g., conservative release calculations should also be performed. This will be defined on a site by site basis consistent with the site-specific licensing requirements.
  - In the event nuclide-specific controls apply, these should also be included in procedures and record systems.
  - In the event that the total activity of the stored waste (inventory) approaches the current design assumptions after the appropriate decay corrections have been applied to that inventory, an evaluation of the operating strategies should be performed to define any additional precautions for storage and/or strategy changes. Decay corrections also should be performed on each waste package prior to shipment. (See also section 4.3.1.)
- *Prior to start-up, ensure that other procedures have been (1) written, (2) approved by management, and (3) are available to storage facility workers for the following: [1,2]*
  - Perform periodic radiological surveys if radioactive materials or waste are stored in the facility. (For the site boundary dose, many plants install thermoluminescent dosimeters (TLDs) to track the accumulated dose.)
  - Perform additional radiological surveys when adding new packages to the storage facility which have dose rates sufficiently high to affect the restricted area boundary dose rate or site boundary accumulated dose.

- Perform additional radiological surveys whenever significant shuffling (rearranging) of stored waste packages or portable shielding has occurred. This would include an evaluation of any potential increase in dose rates within the storage facility due to the movement of low dose rate packages which serve as shielding for high dose rate packages.
- Verify posting and labeling of storage facilities, restricted area boundaries, and waste containers.
- *The results of all surveys, TLD readings, and other methods of radiological monitoring must be documented and available for review. [1]*

2.2.3 Dry LLW and Solidified LLW Storage

- *Ensure that all staging and storage areas for dry or compacted LLW are located in restricted areas where effective material control and accountability can be maintained. [1,2]*
- *Controls should be in place to segregate and minimize the generation of dry LLW to lessen the impact on waste storage. [1]*
  - *Integration of volume reduction hardware or the use of off site volume reduction services should be considered to minimize the need for additional waste storage facilities. [1]*
- *Ensure that the following design objectives and criteria have been addressed for solidified waste storage containers and facilities; [1]* proceduralize where appropriate:
  - *Casks, tanks, and liners containing solidified radioactive waste should be designed to State and local codes to preclude or reduce the probability of occurrence of uncontrolled releases of radioactive materials because of handling, transportation or storage. [1]*
  - *Accident mitigation and control for design basis events (e.g., fire, flooding, tornadoes, etc.) must be evaluated and protected against unless otherwise justified. [1]*
  - *All solidified radwaste should be located in restricted areas where effective material control and accountability can be maintained. [1]*
  - *Although solidified waste storage structures are not required to meet seismic criteria, protection should be afforded to ensure the radioactivity is contained safely in a seismic event. [1]*
  - *Contamination isolation and decontamination capabilities should be developed. [1]*
  - *Provision should be made for additional reprocessing or repackaging because of container failure and/or, as required for final transporting and disposal as per USDOT and disposal facility criteria. [1]*
  - *When significant handling and personnel exposure can be anticipated, ALARA methodology should be incorporated as per Regulatory Guide 8.8 and 8.10. [1]*

2.2.4 Wet LLW Storage

- *Ensure that the following design objectives and criteria have been addressed for wet waste storage containers and facilities; [1]* proceduralize where appropriate:

- *The facility supporting structure and tanks should be designed to prevent uncontrolled releases of radioactive materials because of spillage or accident conditions. [1]*
- *Structures that house liquid radwaste storage tanks should be designed to seismic criteria as defined in the USNRC Standard Review Plan, Section 11.2. [1,44]*
- *Foundations and walls shall also be designed and fabricated to contain the liquid inventory that might be released during a container/tank failure. [1]*
- *All wet LLW storage tanks or containers should be designed to withstand the corrosive nature of the wet waste stored. The duration of storage under which the corrosive conditions exist shall also be considered in the design. [1]*
- *All wet LLW storage structures should have curbs or elevated thresholds, with floor drains and sumps to safely collect wet waste, assuming the failure of all tanks or containers. Provisions should be incorporated to remove spilled wet waste to the radwaste treatment systems. [1]*
- All wet LLW storage tanks and containers shall have provisions to monitor liquid levels and to alarm potential overflow conditions. [1] (Do not confuse stored liquids with stored resin or other wet solid wastes. For wet solid wastes stored in containers (e.g., HICs), it should be acceptable to have the ability to check for water inside the concrete storage module on a periodic basis. However, in the case where wet solid waste can be transferred to the storage tank or container by waste system piping, such as an in-plant resin transfer system, then level alarms are needed.)
- Verify that all potential release pathways of radionuclides (e.g., evolved gases, breach of container, etc.) shall be controlled, if feasible, and monitored in accordance with Part 50, Appendix A (General Design Criteria 60 and 64). [1]
- *Surveillance programs should incorporate adequate methods for monitoring breach-of-container integrity or accidental releases. [1]*

2.3 Security of Stored LLW and Interim Storage Facilities

- Confirm that LLW is stored in a restricted area and is secured against unauthorized removal. [2]
  - *If adequate space in the protected area is not available, the storage facility should be placed on the plant site and both a physical security program (fence, locked and alarmed gates/doors, periodic patrols) and a restricted area for radiation protection purposes should be established. [1]*
- Confirm that access control and security procedures conform to the plant physical security plan. [2] This also applies to RAMQC and any related Safeguards Information (documents, inventories, computer files).
  - *Confirm that storage plans address container protection as well as unauthorized removal of stored waste or other radioactive materials. [1,2]*
  - Access control and security must also conform to any additional controls established in the Transportation Security Plan and Transportation Security Plan Risk Assessment, as specified in 49 CFR 172 Subpart I.

3
GUIDANCE ON RECORDS AND RECORDKEEPING FOR EXTENDED STORAGE

Regulations by USNRC and USDOT mandate keeping records of specific information on packaged low level waste (LLW) shipped for disposal. These recordkeeping requirements are an integral part of existing waste management programs at power plants. Storing waste in an interim on-site storage facility will impose additional recordkeeping requirements on the utility, which relate primarily to storage facility design and capacity evaluations, inventory control, monitoring and inspection.

Regulatory guidance documents provide explicit recordkeeping requirements which are addressed in this Chapter. Nuclear insurance carriers also establish certain recordkeeping requirements, particularly with regard to the duration of record storage (ANI/MAELU Technical Guidelines for LLW storage). Other items are included that are considered prudent for recordkeeping purposes, such as information required for the USNRC's Uniform Low Level Radioactive Waste Manifest in 10 CFR 20, Appendix G. Taken together, all of these guidance documents constitute a comprehensive recordkeeping program.

3.1 Records of Worker Training

- Records of worker training should include:
  - USNRC Inspection and Enforcement (IE) Bulletin 79-19 training
  - Hazmat worker training
  - Transportation Security Awareness training
  - Transportation Security Plan training (including RAMQC considerations)
  - Procedures training
  - Crane and forklift training and qualifications
  - Process Control Program training

3.2 Records of Evaluations for Increased Storage Capacity

- *Maintain a record of the results of such evaluations in accordance with 10 CFR 20.2103(a). [1]*
- *To increase storage capacities authorized in the SAR, or to construct new storage facilities, perform an evaluation of the safety of LLW storage, document that evaluation, and make it available for USNRC staff inspections. Then either: [1]*
  - *amend your licenses where necessary to allow storage of LLW; [1]*
  - *perform a §50.59 evaluation, document the evaluation, and report it to the Commission annually; or [1]*

- *conduct an evaluation under §20.1501 and maintain a record of the results in accordance with §20.2103(a). [1]*

3.3 Records for Inventory Control

3.3.1 General Guidance on Stored Waste

- Records must identify any applicable authorized possession limits and provide adequate accountability to ensure the possession limits are not exceeded [2] (e.g., Part 30 or Part 70 licensees, or if identified during a Part 50 license risk analysis).
- Records must be maintained for all waste placed in storage. [2]
- *Records of waste types, containers, contents, waste forms, dates of storage, dates of inspection, etc., should be maintained. [1,2]*
- Records of radioactive waste shipments.
  - When waste is eventually shipped to an off site processor or to a disposal facility, all of the information on the USNRC's Uniform LLW Shipping Manifest will be needed. Utilities should consider capturing supporting data as early in the storage period as possible.

3.3.2 Specific Guidance on Stored Waste Container Records

- Container Identification Code (i.e., unique container ID)
- Date Placed in Storage
- Reference Decay Date – This is the date that the nuclide distribution (e.g., scaling factors, correlation ratios) was established. Typically, this is the date that the activity was measured or the survey was performed. It is needed for decay correction calculations to determine the radionuclide content after a specified storage period. The decay corrected radionuclide content would be used in the inventory control function and in the shipping and disposal functions.

  (Note: In the event that the total storage inventory is approaching a level that requires possible changes to normal operating procedures, a decay correction should be performed.)
- Container Storage Location – Should include sufficient detail to locate the container easily. The location detail for high dose rate packages and Radioactive Material Quantities of Concern is of special concern and should have detailed location information for retrieval and periodic inspection.
- Container Manufacturer, Type and Model Number
- Container Manufacturer's Serial Number – The container integrity monitoring program will likely require certain numbers of containers of each type and manufacturer to be inspected at programmed intervals. For high integrity containers, a manufacturer could change design details over the storage period. Thus, it could later prove important to know exactly when a container was manufactured in order to trace it back to a certain container lot number. These could be subjected to intensified monitoring or be listed as candidates for early disposal.
- Date of Packaging (or Date Packaged)

- Chemical Form (Bulk waste) – This refers to the most prevalent chemical form of the waste. In addition, if the waste was generated as part of a large decontamination process, the process also should be indicated.

  Note: Utilities which are unable to obtain high quality characterization of waste streams or packages should consider saving a clearly labeled lab size sample of each batch of high dose rate, processed waste (such as dewatered resin) placed in storage. If any questions concerning the nature of the waste in storage arise during the storage period, samples will be available for analysis without the need of trying to sample closed waste packages.

- Total Activity
- Radionuclide Identity and Quantity
- Chelating Agents (>0.1% by volume)
- Solidification Agent – Include any sorbent, solidification binder, or stabilization media.
- Quantity of H-3, C-14, Tc-99 and I-129 – The isotopes, H-3, C-14, Tc-99 and 1-129, are generally considered to be highly mobile in a disposal environment and, therefore, are most often limiting in terms of radiation exposure hazard associated with the disposal site. The quantity of each of these four nuclides is required by 10 CFR 20, Appendix G, to be included on the Uniform Low Level Waste Manifest.
- Waste Class in Accordance with 10 CFR 61

3.3.3 Utility-Specific Data

In addition to the preceding data, each utility should evaluate its own unique situation with respect to waste storage documentation. Some utility-specific data may include:

- Information on waste potentially vulnerable to biological action.
- Documentation on any locally tested and certified IP-2 or Type A packages.
- Process Control Program historical file related to waste processing and stabilization.
- A review of state-specific regulations and requirements related to storage.

3.4 Records of Monitoring and Inspections

3.4.1 General Guidance for Facility Monitoring and Inspection Records

- Records must be maintained to demonstrate that: [2]
  - inspections of LLW packages are being performed to assure they maintain integrity; [2]
  - radiation surveys of individual packages and the storage area, in general, are being performed; [2]
  - any required effluent sampling is being performed; and [2]

- security inspections are being performed. [2]

- Records of tests and inspections of installed fire protection systems. [2]

- Records of tests and inspections of installed ventilation systems, radiation alarms, and continuous air monitors.

- *Records of the results of all surveys, thermoluminescent dosimeter (TLD) readings, and other methods of radiological monitoring. [1]*

3.4.2 ***Specific Guidance for Container Monitoring and Inspection Records***

Each plant will want to develop its own documentation format of monitoring and inspection items. The following items should be included in inspection documentation:

- Container identification number
- Contents description
- Storage location
- Date placed into storage
- Inspection Reference – If a container is inspected during storage, an inspection report should be generated. For container-specific inspections and sampling, the inspection report and any subsequent inspection data become part of the overall characterization of that package. The package record should include a reference to the report or filled in data sheet that is generated. (This will most likely be a quality control (QC) surveillance report.)
- Date of Last Inspection – Unless a container breach is suspected, it is likely that only a small percentage of the containers will receive a detailed inspection during the storage period. Hence, inspection dates need only be recorded for those containers actually evaluated.
- Inspection techniques used
- Evidence of deterioration (e.g., corrosion, bulging of container, leaks, surface contamination)
- Details of any handling damage or other defects (e.g., dents, gouges, crushing)
- Evidence of unstable package stacking (e.g., tilting, crushing of lower containers)
- Conclusions
- Recommendations for additional action
- Name(s) of inspector(s)
- Name(s) of reviewer(s)
- Appropriate attachments (photographs, liquid analysis results, radiation surveys, etc.)

3.4.3 Guidance on Transportation Security Plan Considerations for Waste Stored On-site

On-site storage of waste packaged for disposal falls under the facility Transportation Security Plan. The following records should be retained:

- Copies of Transportation Security Plan and associated Risk Assessment. (These may be controlled in a centralized location due to the possible confidential nature of the included security information.)
- Records of actions taken to respond to Security Hold Points (action items) identified in the Risk Assessment.
- Records of training required in accordance with the Transportation Security Plan.
- Records of audits, assessments, peer reviews, etc., related to the Transportation Security Plan.
  - Records of actions taken in response to such assessments.
- Records of any stored containers/packages which contain Radioactive Material Quantities of Concern. [59].

3.5 Data Storage and Retrieval

It is important that database information and supporting data be reasonably retrievable. Some suggestions to aid retrievability are:

- The storage facility operator should know where hard copy records are archived.
- **RECOMMENDATION:** Preference should be given to using the existing nuclear plant document control system, as many waste records are already stored there, and the records personnel are very knowledgeable on record retention techniques.
- **RECOMMENDATION:** It is recommended that storage records be maintained in electronic format.
  - Where possible, the database should be located on a network level computer, which offers greater protection from loss and greater security from theft. (Such data may be used for malicious purposes, as discussed in various NRC issued or endorsed guidance documents on Radioactive Material Quantities of Concern and Radionuclides of Concern. [59])
  - Retain a backup copy of all software applications used to create and manage the database. (Data could be stored longer than such applications are available on the market.)
  - Backup copies of all electronic databases should be maintained in a separate, secure location from the original database.
  - Maintain the data hardware and storage media in a reasonably current technology. This may require periodic migration of data to new hardware.

Note: Electronic data management technology has a short service life. Efforts should be made to ensure that the data storage system does not become obsolete by the end of the storage period. This challenge is often compounded by shuffling older computer equipment to storage operations and separating storage databases from the normal plant

data network. There are many instances of data being recorded in electronic format and not being retrievable later because the original hardware became obsolete.

- Maintain current data by container or waste package number. Essentially, the entire history of any waste should be traceable by the waste container number from the point of collection to the point of disposal, including repackaging.
  - For electronic databases, the container ID number should be the key waste tracking and record link for all storage activities, inspections, etc.
  - If radiofrequency identification device (RFID) tagging is used, the container ID will be the connecting point between the RFID tag information and the storage database.

4
GUIDANCE ON WASTE CONTAINERS FOR EXTENDED STORAGE

The USNRC places requirements on the permitted containers for storage and disposal. The USDOT also places requirements on packages and packaging used in transporting the waste to the disposal site. Nuclear insurers provide guidance on container storage based on lessons learned from industry storage experience. Ideally, containers used for on-site storage and eventual disposal will meet all regulatory and disposal requirements and guidance when first placed in storage (although that is not a requirement). This Chapter summarizes the regulations and guidance that are relevant to waste containers for on-site storage.

Note: American Nuclear Insurers discourages outdoor storage, although recognizing that some plants have no other option. [4] Outside storage may, therefore, impact insurance rates, which should be factored into any cost analyses for storage facility design.

4.1 General Guidance

The following design objectives and criteria are applicable for dry low level waste (LLW) storage containers and facilities: [1]

- *Containers should generally comply with the criteria of 10 CFR Part 71 and 49 CFR Part 170 to minimize the need for repackaging for shipment. [1]*
- Radioactive waste and radioactive material containers should, as a minimum, meet the requirements of a IP-1 package (e.g., 55 gallon drums, B25 boxes, sealand containers, high integrity containers (HICs), metal liners, etc.). [4]
- Guidance should be provided regarding container integrity requirements and acceptance criteria. [4] A determination should be made to ensure the integrity of each container and package used for each waste type and waste stream. [2]
  - Determine which wastes can be stored in each container/package.
  - Determine which wastes cannot be stored in each container/package.
- *The waste container should be designed to ensure radioactive material containment during normal and abnormal occurrences. [1]*
- *The waste container materials should not support combustion. [1]*
- Radioactive wastes and materials should be repackaged when containers are degraded to the point where integrity is questionable or leaking. [4]

- On-site storage facilities for radioactive waste and radioactive material should incorporate the necessary features to allow for removal of containers in storage. [4]

- Each container should be accessible and retrievable in order to provide timely removal and repackaging of problem containers. [4]

- Radioactive wastes and materials can be repackaged in outdoor areas assuming appropriate radiological controls are in place. Note that while acceptable, this is not a preferred option as it exposes the licensee to increased liability related to environmental and personnel exposure controls. [4] It is also important to note that repackaging refers specifically to transferring the waste material from one container to another (versus placing a waste container in an overpack).

- *Waste stored in outside areas should be held securely by installed hold-down systems. [1]*
  - *The hold-down system should secure all containers during severe environmental conditions up to, and including, the design basis event for this waste storage facility. [1]*
  - The above considerations should be addressed as part of the safety analysis (e.g., 50.59 review) for on-site storage modules and other outside storage containers. Refer also to the discussion in section 2.2.1 related to hold-down considerations for outside storage pads.

- The laterals (internals) for dewatering liners and HICs are certified for finite time periods (e.g., five years). Dewatered resin stored for more than the certification period will generally need to be re-dewatered. This must be considered when selecting the waste container internals and balancing that selection against the anticipated storage duration. Note that some liners and HICs come with sampling tubes which may allow for verification of "no free-standing liquids" and, therefore, eliminate the need for dewatering via the laterals after their certification has expired. **RECOMMENDATION**: Consider requiring sampling tubes on all liners and HICs used for storing dewatered wastes and thermal residue (e.g., steam reformed resin).

4.2 ALARA and Radiological Guidance

- *All packages must be clearly labeled in accordance with 10 CFR 20.1904(a) and 20.2006. [1]*

- Configuration (e.g., placement, stacking, etc.) of the radioactive waste or radioactive material containers within the building or outdoors is important. [4]
  - Waste should not be stacked in such a way that it will increase the hazard of damaging the container or spilling the contents. [4]
  - Higher dose rate items should be segregated and/or shielded. [4] This should be accomplished in accordance with the site ALARA plan.

- *Increased container handling and personnel exposure can be anticipated during storage. Consequently, the methodology for maintaining exposures as low as reasonably achievable (ALARA) should be consistent with USNRC Regulatory Guides 8.8 and 8.10. [1,39,40]*

4.3 Guidance on Corrosion Protection

- *Container integrity should be ensured against corrosion from the external environment: external weather protection should be included where necessary and practical. [1]*

- All containers should be selected and stored to prevent container degradation due to corrosives, environment, and physical/mechanical stresses. [4]

• *Compatibility of container materials with waste forms and with environmental conditions external to the containers is necessary to prevent significant container corrosion. [1]*

- *Container selection should be based on data that demonstrates minimal corrosion from the anticipated internal and external environment for a period well in excess of the planned storage duration. [1]*
- *Container integrity after the period of storage should be sufficient to allow handling during transportation and disposal without container breach. [1]*
- *If liquids exist that are corrosive, proven provisions should be made to protect the container (i.e., special liners or coatings) and/or to neutralize the excess liquids. [1]* For example, experience at Ontario Power Generation indicated that liquids in resin containers had a low pH following extended storage, which they contribute to cation resin breakdown releasing sulfur [57].
- *Potential corrosion between the solid waste forms and the container should also be considered. In the case of dewatered resins, highly corrosive acids and bases can be generated that will significantly reduce the longevity of the container. [1]*
- *The Process Control Program should implement steps to ensure the above incompatible and corrosive conditions do not occur. [1]*
- *Container material selection and coating should ensure that container breach does not occur during interim storage periods. [1]*
- *If deemed appropriate and necessary, highly non-corrosive materials (e.g., stainless steel) should be used. [1]*
- Containers must be compatible with the waste/material being stored and should be suitable for the anticipated storage conditions. [4]

• *Storage containers should be raised off storage pads, where water accumulation can be expected to cause external corrosion and possible degradation of container integrity. [1]*

• The long term integrity of the container grapple rings, lifting lugs, and slings should be evaluated along with the rest of the container.

4.4 Guidance for Container Design and Testing

4.4.1 Key Package Design Requirements Applicable to LLW Storage

General package design requirements are set forth in 49 CFR 173.410. The following general requirements may apply to stored waste containers if and when a licensee decides that a waste container has been re-designated as a transport waste package in accordance with the definitions in section 1.2:

• *Containers can be easily handled.*

• *Container lifting attachments are capable of handling three times the container gross weight.*

- *Lifting attachments must be testable and capable of being proven competent for use at the end of the storage period (i.e., waste packages must be safely retrievable at the end of storage).*
- *Container must be free of protrusions and easily decontaminated.*
- *Design should permit no water accumulation on outer surfaces.*

  (In general, this applies to a container that:

  - serves as both the waste storage container and the transport waste package, or
  - is not designed to withstand long periods of exposure to moisture, or
  - for situations where a realistic potential exists for degradation of the integrity of the stored transport waste package.

  Generally, this does not apply to waste containers stored within enclosed storage modules that protect the waste container, or to high density polyethylene high integrity containers. In general, it is not expected that minor moisture condensation from thermal cycling would be sufficient to degrade the integrity of a package. Periodic inspections, and inspection before transport, should specifically address degradation to ensure of the integrity of the package is maintained.)
- *There should be no unsafe add-ons to the container.*
- *Container contents should be compatible with container materials.*

Note that most steel liners have not been tested to meet the IP-2 qualification criteria in 49 CFR 173 or those of 10 CFR 71.71 but could continue to be shipped in casks. There is no indication that there is any problem with their acceptance at disposal sites for solidified or Class A wastes. However, utilities should seriously consider coating these containers for longer-term integrity.

USNRC regulation 10 CFR 61.56 [47] provides the basis for regulating packaging wastes for disposal, which has applicability to waste containers used for storage. It provides the minimum requirements to facilitate handling at the disposal site. In addition, statements in the USNRC Branch Technical Position [32] further expand the USNRC's position on waste packaging. The following paragraphs identify the key USNRC requirements for all waste containment for disposal—and which also have applicability to on-site storage.

4.4.2 10 CFR 61.56 [47]

- *Waste must not be packaged for disposal in cardboard or fiberboard boxes. [47]* This applies primarily to utility dry solid waste (DSW).

4.4.3 USNRC Branch Technical Position (BTP) [32]

- *The container should be resistant to degradation caused by radiation effects. [32]*
- *The container should be resistant to biodegradation. [32]*
- *The container should remain stable under the compressive loads inherent in the disposal environment. [32]*
- *The container should remain stable if exposed to moisture or water after disposal. [32]*

- *The as-generated waste should be compatible with the container. [32]*

The regulations also call for testing to grant approval (certification) of the waste forms. The USNRC stopped issuing topical reports on LLW and no longer approves waste forms. Waste form submittals must now be made to individual states or to the E-5 Committee of the CRCPD (Conference of Radiation Control Program Directors) as coordinated by the USDOE at Idaho National Labs. Refer to the BTP for detailed HIC design and acceptance criteria.

5
GUIDANCE ON WASTE FORMS FOR EXTENDED STORAGE

It is the USNRC's position that it is desirable to place waste into storage in a form suitable for disposal, but only if there is sufficient assurance that the waste will ultimately be acceptable for disposal. [1] The guidance in this Chapter addresses both waste that is processed and ready for disposal, as well as waste that has been safely packaged but is in a form that is easily reprocessed or repackaged to meet future disposed waste acceptance criteria.

5.1 General Guidance on Waste Form

- *Where possible, waste should be processed before storage, packaged in a form ready for transport and disposal at the end of the storage period in accordance with the requirements in 49 CFR Parts 170-189 and 10 CFR Part 61 respectively. [1]*
- *Where a disposal route has not yet been defined, waste should be processed and stored safely in a form that will not unreasonably foreclose future options. [1]*
- *Adequacy of the waste form or package should be reassessed before disposal. [1]* Industry experience suggests that this should be applied to every package.
- Some waste forms (i.e., liquids) are not appropriate for long term storage. [4]
  - Industrial waste forms (e.g., corrosives, hazardous materials, flammables, etc.) should not be stored with radioactive wastes/materials. [4]
  - Raw (untreated, unprocessed) radioactive waste or unpackaged radioactive materials should not be placed in the LLW storage facility. [4]
- *The packaged material should not cause fires through spontaneous chemical reactions, retained heat, etc. [1, 47]*
- *All wet LLW in interim storage will require additional reprocessing before shipment offsite. [1]*
  - Industry experience supports this USNRC guidance as being applicable to waste stored for as little as 90 days.
  - As a minimum, each wet LLW package should be evaluated to verify it meets the waste acceptance criteria for disposal prior to shipment to a disposal facility, with special attention given to the amount of free-standing liquid. (Refer specifically to 10CFR61.56(a)(3).)

5.2 Guidance for Minimizing Fire Hazards

- Strict application of a plant's process control program (PCP) and chemical control program should prevent any dangerous chemical mixtures in any of the wastes generated by the plant.
- Careful characterization of the wastes prior to packaging will help ensure that the waste packages will not contain incompatible materials.
- Filling and closing the storage packages, thus minimizing voids, will act as an additional barrier in preventing internally generated fires.
- Any remaining waste packages that may represent a fire hazard will need to be stored in fire protected areas with appropriate fire suppression equipment or systems.

5.3 Guidance for Minimizing Gas Generation

- *Gas generation from organic materials in waste containers can also lead to container breach and potentially flammable/explosive conditions. [1]*
  - *To minimize the number of potential problems, the waste form gas generation rates from radiolysis, biodegradation, or chemical reaction should be evaluated with respect to container breach and the creation of flammable/explosive conditions. [1]*
  - *Unless storage containers are equipped with special vent designs that allow depressurization and do not permit the migration of radioactive materials, resins highly loaded with radioactive material, such as boiling water reactor water cleanup system resins, should not be stored for a period in excess of approximately 1 year. [1]*
  - **RECOMMENDATION:** Accordingly, for resin which is likely to be stored for a period in excess of 1 year, a passive vent is recommended.

Source Controls

To minimize the potential for gas generation in LLW, suitable source controls should be instituted. Source controls alone can dramatically reduce the probability of gas generation in LLW packages due to biodegradation and chemical reactions, and radwaste managers are encouraged to use these preventive means. Examples of source control include:

- waste stream segregation to the greatest practicable degree (e.g. condensate polisher resins are considerably less likely to support biological growths than are radwaste treatment resins);
- adherence to operating procedures and quality control measures in LLW collection, sorting, segregation, and characterization;
- proper housekeeping and a high degree of cleanliness in areas, equipment and systems where radioactive wastes are generated, handled and treated, so that the probability of biological agents or nutrients (including sanitary waste) entering **or** contaminating the radioactive waste stream(s) is minimized;
- contain and separate oils, grease, solvents and similar hydrocarbons, high detergent-content (especially phosphorus-based) aqueous wastes, etc.

Other Considerations

- Biocides may be applied to control biological growths in certain instances, but only as a last resort and when there is a known, well understood problem.
  - Biocides are relatively short term inhibitors of biological growth, and need to be reapplied periodically.
  - Some biocides should be avoided since they may contain components qualified as hazardous by the USEPA (i.e., result in a mixed waste).
- Oxidizers (i.e. chlorine, chlorites, peroxides) must not be used without full consideration given to potential reactions with the waste forms, containers, seals and gaskets.
- To minimize the possibility of a chemical reaction that would lead to gas generation, a strong chemical control program which prevents mixing of the waste with highly oxidative or other undesirable chemicals should be in place .
- To minimize the potential for radiolysis, ion exchange resin should be removed from service before accumulating levels of radionuclides that can lead to radiolytic decomposition [57]. This applies primarily to decontamination resins (i.e., resin generated during system decontamination projects), since the plant process resins usually do not accumulate sufficient activity.
- Venting devices may be needed to vent the generated gas and relieve the pressure inside the container.
- The potential for gas generation can be reduced by the selection of a suitable waste form. For instance, solidification of wet wastes, such as spent ion exchange resins and filter media, will substantially reduce the potential for gas generation. However, waste solidification is not a universal solution: for example, solidification of incinerator ash in cement may lead to significant gas generation. Other waste forms, such as vitrification or melting, may prove preferential for this waste type.

5.4 Other Regulations and Regulatory Guidance on Waste Form

USNRC regulation 10 CFR 61.56 [47] provides the basis for regulating waste forms for disposal, which has applicability to waste storage. In addition, statements in the USNRC Branch Technical Position [32] further expand the USNRC's position on waste forms. The key USNRC requirements for all disposed waste forms—and which have applicability to stored waste forms—are as follows:

5.4.1 10 CFR 61.56 [47]

- *Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the fluid. [47]* This rule applies primarily to utility oils.
- *Solid waste containing liquid shall contain as little free-standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume. [47]* Applicable to resins, evaporator bottoms, sludges, and filters.
- *Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water. [47]* Applicable to decomposition of organic resins into hydrogen and methane from gas generation.

- *Waste must not contain, or be capable of generating toxic gases, vapors, or fumes harmful to persons "transporting, handling, or disposing of the waste." This does not apply to radioactive gaseous waste. [47]* This does apply to concerns over decomposition of organic resins into hydrogen and methane, resulting in gas generation.
- *Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable. [47]* This is not particularly applicable to most utility wastes.
- *Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20°C (68°F). Total activity must not exceed 100 curies per container. [47]* Not particularly applicable to utility wastes.
- *Waste containing hazardous, biological pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials. [47]* Some wastes, such as liquid scintillation vials from bioassay (urine samples) could fall into this class for international utilities and government facilities.

The regulations in 10 CFR 61 have additional requirements for Class B and C wastes. These wastes must be able to maintain structural stability to inhibit slumping, collapse, or other failure of the disposal trench that could lead to radionuclide migration. Regulations stipulate a period of 300 years as the minimum time a Class B or C waste must retain its integrity. The additional requirements for these higher-level wastes are as follows.

5.4.2 USNRC Branch Technical Position (BTP) [32, 61]

- *The waste should be a solid form or in a container or structure that provides stability after disposal. [32] All Class A liquid wastes, however, require solidification or absorption to meet the free liquid requirements. [61]*
- *The waste shall not contain free-standing and corrosive liquids. That is, the wastes should contain only trace amounts of drainable liquid, and in no case may the volume of free liquid exceed 1% of the waste volume when wastes are disposed of in containers designed to provide stability, or 0.5% of the waste volume for solidified waste. [32, 61]*
- *The waste should be resistant to degradation caused by radiation effects. [32, 61]*
- *The waste should be resistant to biodegradation. [32, 61]*
- *The waste should remain stable under the compressive loads inherent in the disposal environment. [32, 61]*
- *The waste should remain stable if exposed to moisture or water after disposal. [32, 61]*
- *The as-generated waste should be compatible with the solidification media or container. [32, 61]*
- Recognizing that all LLW is intended for disposition at the end of the interim storage period, the waste must meet the waste form requirements for stability set forth in the USNRC *Technical Position on Waste Form, Rev. 1* [61] prior to disposal. The referenced document includes guidance on (1) the processing of wastes into an acceptable, stable waste form, (2) the design of acceptable high integrity containers, (3) the packaging of filter cartridges, and (4) minimization

of radiation effects on organic ion-exchange resins. The regulations in 10CFR20.311(d)(1), 10CFR20.2006(d), and Section III.A.1 of Appendix F to 10CFR20.2001-2401, requires waste generators and processors to prepare wastes that meet the waste characteristics requirements of Part 61 (including the requirements for structural stability). The recommendations and guidance provided in this technical position are an acceptable method to demonstrate waste stability. [61]

6
GUIDANCE ON MONITORING AND INSPECTION FOR EXTENDED STORAGE

Inspection efforts for storage facilities are generally geared toward assuring that licensees who are storing low level waste (LLW) for extended periods are in compliance with possession limits and license conditions, and do not develop an "out-of-sight, out-of-mind" attitude. This is normally accomplished by examining the licensee's records to ensure that the required surveys, inspections and accountability checks are being done and then following up with a physical examination of the storage area and waste containers/packages. [2]

The guidance in this Chapter includes facility inspections, surveillances, radiological monitoring, and as low as reasonably achievable (ALARA) considerations. A formal surveillance program should be established to detect failure or degradation of radioactive waste/material storage containers.

- Inspections, surveillances, tests, and other monitoring should be performed by individuals trained in accordance with:
  - USNRC IE Bulletin No. 79-19, "Packaging of Low Level Radioactive Waste for Transport and Burial." [4,11]
  - USNRC requirements related to handling, packaging and storage of Radioactive Material Quantities of Concern (RAMQC). [59]
  - USDOT regulations in 49 CFR 172 Subpart I related to (1) transportation Security Awareness training, and (2) Transportation Security Plan training.
  - Other USDOT hazmat training requirements, as applicable.

6.1 Guidance on Facility Inspections and Monitoring

- Determine whether the procedures for placement, inspection, and repackaging of LLW are clear and available to all who need to use them, and that they have been approved by management. [2]

- *Verify program documentation exists and is available for: [1,2]*
  - *inspections of LLW packages to assure they maintain integrity; [1,2]*
  - *radiation surveys of individual packages and the storage area, in general; and [1,2]*
  - *any required effluent sampling. [1,2]*

- Inspect the storage area(s) to verify it is being properly maintained with respect to:
  - Access to and housekeeping around waste packages.
  - Lighting provided for visual inspections and to permit identification of unsafe radiological and non-radiological conditions. [2]

    Note: Verify lights are functioning and adequate for the intended purpose. Over time, as the number of stored waste containers increases, the available light to some storage areas and containers will decrease.

- *Confirm that all LLW is stored within a restricted area. [1,2]* (In this case, "restricted area" refers to radiological controls. Adequate security considerations also apply to all stored LLW, which are addressed elsewhere in these guidelines or in the licensee's physical security plan.)
- *Confirm that all LLW is secured against unauthorized removal. [1,2]*
- *Confirm that any required checks of fire protection systems have been performed. [1,2,4]*
  - Verify that fire/smoke alarm systems are being monitored in a constantly manned location such as the control room or guard station. [4] In other words, if you have an alarm, you should be able to hear and respond to it 24 hours a day.
  - Verify that personnel monitoring alarms know the correct alarm response.
  - Verify the alarm system(s) is on a routine maintenance schedule, and documentation demonstrates that the system(s) is being properly maintained. [4]

- Confirm that liquid drainage and collection systems, as well as leak detection capabilities (e.g., sump high level alarms, if installed), are functioning properly and that no leakage has escaped the facility. [4] (See also the discussion on electronic leak detectors and sump alarms in section 3.2.1.)
  - Verify that leak detection alarms are being monitored in a constantly manned location such as the control room or guard station. [4] In other words, if you have an alarm, you should be able to hear and respond to it 24 hours a day.
  - Verify that personnel monitoring alarms know the correct alarm response.
  - Verify the alarm system(s) is on a routine maintenance schedule, and documentation demonstrates that the system(s) is being properly maintained. [4]

- *Determine whether the correct type of container/packaging is being used to maintain the package integrity. [1,2]*
- Check that waste containers are visible to allow routine inspection and that they are readily accessible to workers and inspectors. [2]
- Confirm that the placement or stacking of containers is stable and that the containers are not deformed under load, or likely to fall. [2,4]

- Confirm that the containers are protected from reasonably expected environmental conditions, including fire and flooding, and that the storage location is not subject to extremes of temperature or humidity (i.e., near a boiler room, laundry area, etc.). [2]

- Check ventilation of the storage area to determine if it is sufficient to prevent build-up of any gases produced by waste decomposition. [2]
  - Verify that any installed ventilation equipment is working properly and is being maintained in accordance with a documented preventive maintenance schedule.
  - Verify that any ventilation equipment has the correct filters installed and that filters and charcoal replacement frequencies are specified in the preventive maintenance schedule. (This only applies where the facility design calls for such equipment, filters, and/or charcoal media.)

- If outdoor storage is necessary, the following minimum program elements should be implemented: [4]
  - A formal surveillance program should be established to detect failure or degradation of radioactive waste/material storage containers; [4]
  - Routine contamination and dose rate surveys should be performed; [4]
  - Periodic storm drain samples should be taken and analyzed. [4] The frequency should generally be consistent with the normal sampling frequency for all other plant storm drains;
  - The pad should be adequately bermed to allow for the collection of rainwater and/or leakage from the stored containers; and [4]
  - Collected water should be routinely monitored and, if necessary, processed prior to discharge. [4]
  - It is considered that the above requirement for a bermed pad can be met if the outside storage module is designed and capable of collecting any liquid that escapes the waste container inside the storage module. This should be addressed in the safety analysis.

6.2 Guidance on Individual Container Inspections and Monitoring

- *All inspection procedures developed should minimize occupational exposure. [1]*

- *A program of at least periodic (quarterly) visual inspection of container integrity should be performed for a representative number of packages. [1,2,4]*
  - *Visual inspections should include and evaluation of container integrity/breach, damage, swelling, corrosion products, seals, latches, retaining clips, markings/labels. [1]*
  - Waste stored within an environmentally controlled building may support a reduced inspection frequency of every six months. [4] (Note that this is <u>not</u> specified in

USNRC guidance documents and should be supported with documentation from stored waste historical trends.)

- *The use of high integrity containers (300-year lifetime design) would permit an inspection program of reduced scope. [1]*
  - **RECOMMENDATION:** Initially, inspecting a rotating 10% of the high integrity containers in storage annually is recommended; but each utility should establish its own HIC sampling program. Again, historical trends will demonstrate if this percentage should be revised. [18]
- **RECOMMENDATION:** Initially, inspecting 5% of steel waste containers (drums, boxes, liners) in storage each quarter is recommended; but each utility should establish its own inspection sampling program. Tracking historical trends will demonstrate if this percentage should be increased or decreased. [18]

- *Inspections can be accomplished by use of television monitors; by walk-throughs if storage facility layout, shielding, and the container storage array permit; or by selecting waste containers that are representative of the types of waste and containers stored in the facility and placing them in a location specifically designed for inspection purposes. [1]*

- Container inspection frequencies and sampling sizes should be revised based on the presence of secondary containments or the performance of waste containers over time.
  - Extending inspection frequencies should be done only when supported by historical trending data based on careful inspections which are well documented.

- New or refurbished waste containers should be inspected to detect manufacturing defects or handling damage that could render them unsuitable for waste storage or could accelerate their deterioration.
  - This also applies to containers which have been stored in an empty condition or exposed to an outside environment for an extended period of time. (Stored empty containers can degrade quickly if not properly stored.)
  - Inspect the storage location of empty containers.
  - Empty polyethylene HICs should be stored inside or are otherwise shielded from UV rays which could degrade the containers. (Manufacturer specification.)

- Consider inspecting secondary or tertiary containments in lieu of direct inspection of primary waste containers.

- Consider using liquid detection and analysis and/or gas detection and analysis as a supplement to, or alternative for, visual inspection of waste containers.

6.3 Guidance on Inspections for Dry Solid LLW and Solidified LLW Storage

- *Potential release pathways of all radionuclides present in the solidified waste form shall be monitored as per Part 50, Appendix A. [1]*
- *Surveillance programs shall incorporate adequate methods for detecting failure of container integrity and measuring releases to the environment. [1]*
- *Perform direct radiation and surface contamination monitoring of waste containers to ensure that levels are below limits specified in 10 CFR 20.1502 and 20.1906, and 40 CFR 173.397. [1]*
  - *All containers should be decontaminated to these levels or below before storage. [1]*
  - *Inspect liquid drainage collection systems and sample all collected liquids. [1]*
  - The results of any sampling should be documented for future inspections.
  - Action items resulting from liquid sampling should be documented for future inspections.
  - Review the action items resulting from previous inspections and sampling to verify appropriate followup actions were implemented. [2]
  - *Route any collected liquids to radwaste systems if contamination is detected or to normal discharge pathways if the water ingress is from external sources and remains uncontaminated. [1]*
  - If radioactive waste or radioactive material containers are stored outdoors, adjacent to the storm drain system, periodic storm drain samples should be taken and analyzed. [4]
- *Verify that all waste stored in outside areas are held securely by installed hold-down systems. [1]*
  - *The hold-down system should be adequate to secure all containers during severe environmental conditions up to, and including, the design basis event for this waste storage facility. [1]*
  - Verify any required hold-downs are in place, secure, and in good repair.
- *Verify that container integrity is ensured against corrosion from the external environment and that external weather protection is used where necessary and practical. [1]*
- *Verify all storage containers are raised off storage pads, where water accumulation can be expected to cause external corrosion and possible degradation of container integrity. [1]*
- *Procedures should be developed and implemented for early detection, prevention and mitigation of accidents (e.g., fires). [1]*
- Verify that storage facility workers are trained, as applicable, in accordance with:

- USNRC IE Bulletin No. 79-19, "Packaging of Low Level Radioactive Waste for Transport and Burial." [4,11]
- USNRC requirements related to handling, packaging and storage of Radioactive Material Quantities of Concern (RAMQC). [59]
- USDOT regulations in 49 CFR 172 Subpart I related to (1) transportation Security Awareness training, and (2) Transportation Security Plan training.
- Other USDOT hazmat training requirements, as applicable.

6.4 ALARA and Other Radiological Monitoring Guidance

• Perform periodic (quarterly) contamination and dose rate surveys for the facility and for waste packages and whenever material is removed from or placed into the facility. [4]

• *Inspect the facility to ensure all radiological postings are accurate and present in accordance with 10 CFR 20: [1,2]*

- within the building.
- at the exterior of the building.
- at all exit doors.
- at the restricted area boundary.

• *Verify that monitoring is being performed at the site boundary for the storage facility and that records are being maintained for all site boundary dose measurements (e.g., thermoluminescent dosimeter (TLD) readings). [1]*

• Surveys should include general area radiation and contamination surveys as well as the monitoring of the radioactive waste or radioactive material containers for surface contamination. [4]

• Special radiological surveys (e.g., soil samples, smears, direct frisk, etc.) should be performed when container breach is suspected; [4]

• Storage facilities (buildings) should be monitored by Continuous Air Monitors. [4] (In at least one utility storage facility, American Nuclear Insurers has recognized continuous air sampling systems as an acceptable alternative.)

- Ensure that any required monitoring is being performed.
- Verify that the monitoring equipment is operational.
- Verify that the results of monitoring are being saved and evaluated, and that any such evaluations are being documented.

• *Verify that inspected packages are properly labeled. [1,2]*

- This requirement specifically refers to transport waste "packages." However, licensees are also required to label or tag all waste containers with their radioactive

contents. When a waste container or transport waste package is stored within a waste storage module or storage shield, it is recommended that the storage module/shield be posted and that each LLW container or package within the storage module/shield be tagged so as to identify the contents in accordance with 10CFR20. Tags sometimes become separated from containers/packages; therefore, it is further recommended that the tag on the waste container or package include a unique serial number or other unique identification or be cross referenced to the container serial number. The container and tag number should be directly linked to container records.

- Verify that ALARA considerations are being used in the placement of the higher activity waste containers in the storage area. [2]

• Action levels and limits should be established for the above radiological surveys and monitoring. [4]

- Action items resulting from liquid sampling should be documented for future inspections.
- Review the action items resulting from previous inspections and surveys to verify appropriate followup actions were implemented. [2]

7
GTCC WASTE STORAGE CONSIDERATIONS AND GUIDELINES

7.1 Overview

Greater that Class C (GTCC) waste is a waste designation that is unique to the USA nuclear industry. It refers to the upper end of the international ILW (intermediate level waste) classification. GTCC waste is low level waste (LLW) which exceeds the activity limitations for near-surface disposal set forth in USNRC regulations 10 CFR 61.55. [47, 62]

At the present time, there is no licensed disposal facility for GTCC waste in the USA. This situation forces commercial nuclear reactors to store GTCC waste *on-site* until a disposal facility is constructed and licensed.

In October 2001, the USNRC revised its regulations in Part 72 [56] to accommodate concurrent storage of GTCC waste in an interim spent fuel storage installation (ISFSI). In addition to resolving numerous regulatory issues, this revision had three key effects:

(1) A long term storage solution was established for GTCC waste independent of a Part 50 operating license. This allows for termination of the Part 50 license at the end of decommissioning.

(2) A long term storage solution for GTCC waste impacts on GTCC waste generation similar to a disposal solution: both long term solutions have the effect of removing a long-standing nuclear plant operating practice of taking measures to avoid GTCC waste generation.

(3) If the Barnwell LLW repository closes to out-of-region waste, as is currently required by South Carolina law, most USA commercial nuclear plants will lose their disposal option for Class B/C wastes by mid-2008. This represents a significant high activity storage volume impact. However, given the advanced state of technology for volume reduction and concentration, most Class B/C waste could be reduced in volume by factors ranging from 5:1 to more than 30:1 by conversion to GTCC waste. The availability of a long term GTCC waste storage option makes this a practical and economic solution to interim *on-site* storage, as well as reducing the overall stored waste inventory.

The downside of converting Class B/C waste to GTCC waste is that disposal options may again become available for Class B/C waste. In contrast, the disposal options for GTCC

waste are likely to remain uncertain for many years. Converting Class B/C waste to GTCC waste would close the door on a potential future Class B/C disposal route.

Shortly after releasing the revised regulation in 10CFR72, the NRC also issued Interim Staff Guidance 17 (ISG-17), *Interim Storage of Greater Than Class C Waste,* [62] to assist affected licensees in planning and implementing GTCC waste storage in accordance with the new regulation.

7.2 Authorized Storage Locations for GTCC Waste

A generator of GTCC waste has the option of storing the waste either in an ISFSI or in a separate LLW storage facility (including outside storage pad and *on-site* storage modules). For waste stored in a LLW storage facility other than an Interim Spent Fuel Storage Installation (ISFSI):

- All storage considerations and guidelines addressed in the preceding Chapters apply.
- Additional guidance on GTCC waste container and waste form are provided in this Chapter.
  - Storage in a LLW storage facility offers greater flexibility for waste containers and waste forms, including those discussed in preceding Chapters. This is especially valuable for waste which is still being characterized and evaluated for further processing.
  - If GTCC waste is stored in any container or waste form not discussed in this Chapter, there is a significantly increased probability that the waste will need to be repackaged prior to disposal.
- Careful attention should be paid to the allowable radionuclides and activity limits, as GTCC wastes contain a significant quantity of one or more longer lived nuclides.
- Outside storage is discouraged by nuclear insurers. [4]
- Outside storage of GTCC waste likely represents a potential increase in security concerns (threat of malicious intent), depending on the location of the storage area and the type of storage modules.

Table 8-1 summarizes the licensing authorizations for the various types of radioactive waste which may be stored at an interim spent fuel storage installation (ISFSI). The table makes it clear that the licensee has broad storage options under a Part 50 license. It is also clear that the licensee has multiple options if it desires to terminate its Part 50 license. Note that a specific license obtained under Part 72 intentionally has a much narrower focus.

Table 7-1
Summary of Licensing Authorizations for Radioactive Waste Storage

Waste Types Stored at ISFSI	Part 50	Part 30 [1]	Part 70 [2]	Current Part 72
Spent fuel aged >1 year	✓			✓
Other materials associated with spent fuel storage (including secondary LLW)	✓	✓	✓	✓
Solid GTCC waste	✓	✓	✓	✓
Liquid GTCC waste	✓	✓	✓	[3]
Other LLW (Class A, B or C)	✓	✓	✓	[4]

[1] Byproduct material
[2] Special nuclear material
[3] A survey of decommissioning plants suggests that there is little, if any, liquid GTCC waste which will require *on-site* storage.
[4] Other LLW (Class A, B, or C) cannot be stored in an ISFSI that is specifically licensed under Part 72. An exception applies to such waste which is generated as part of routine ISFSI storage activities, such as inspection and maintenance. However, such excepted waste must be removed and dispositioned in a reasonable period of time.

7.3 GTCC Waste Storage

For GTCC waste stored in a LLW storage facility (i.e., not in an ISFSI), the guidance set forth in preceding Chapters apply. Additional guidance is provided below in the sections on recordkeeping, waste containers, and waste form.

7.3.1 Guidance for Start-Up Evaluation for GTCC Waste Storage

- *Prior to storing GTCC waste in an ISFSI, the licensee must include in its Safety Analysis Report (SAR) how the GTCC waste will be stored to prevent any potential adverse reactions. The SAR should include equipment and facility design, description of planned operations, and other information important to safe receipt, handling, packaging, storage and transfer of GTCC waste. [56, 62]*

- *If a Part 72 specific license has not yet been applied for, then the initial SAR should address GTCC waste storage. [56, 62]*

- *If a Part 72 license already exists, then the SAR must be amended before GTCC waste is stored within the ISFSI. [56, 62]*

- *If GTCC waste storage will be accomplished under a Part 50 license, and if the storage will occur within the ISFSI, then the nuclear plant SAR section governing ISFSI operation must be amended to address GTCC waste storage. [56, 62]*

  Note: Remember that the primary consideration of such SAR submissions is to describe how GTCC waste will be stored to prevent any potential adverse reactions with stored spent fuel.

- *A "72.48 review" (similar to a 50.59 review, but applied to an ISFSI) should be accomplished to identify any potential unreviewed safety questions related to storage of GTCC waste under a Part 72 specific license prior to making any changes, tests or experiments at an ISFSI. This should be accomplished using the same level of careful discipline applied to "50.59 reviews" for an operating nuclear plant and GTCC storage under a Part 50 general license. [56, 62]*

- *A Quality Assurance program must be in place prior to receipt of GTCC waste at an ISFSI. This program is part of the QA program for spent fuel storage, as well as any other radioactive materials or waste stored at the ISFSI. [56, 62]*

- *A program for training, proficiency testing and certification of equipment and control operators is required prior to the receipt of GTCC waste at an ISFSI. This same program is required for supervisors of the equipment and control operators. [56, 62]*

  - *This training must include Transportation Security Awareness Training and Transportation Security Plan Training. [56, 62]*

7.3.2 ***Guidance for Recordkeeping, Reporting, and Training Requirements for Storage of GTCC Waste***

The following guidance is in addition to guidance previously provided for recordkeeping of wastes in a LLW storage facility other than an ISFSI. It applies only to stored GTCC waste containing special nuclear material (SNM):

- *Written accounting procedures must be established for material control and accounting (mathematical accounting) sufficient to maintain an accurate accounting of all SNM received, stored, and transferred from storage. [56, 62]*

- *A physical inventory of spent fuel and GTCC waste containing SNM and stored at the ISFSI must be performed at least once every 12 months. [56, 62]*

- *All inventories must be documented, available for inspection, and maintained in duplicate with the duplicate records stored in a separate, remote location. [56, 62]*

- *Records must show the receipt, inventory (including location), disposal, acquisition and transfer of all GTCC waste containing SNM in storage at the ISFSI. [56, 62]*

- Secondary Class A, B and C wastes generated as part of the normal operation of an ISFSI must be tracked and disposed in an undefined reasonable period of time. This indicates a need to record the dates of waste generation, along with the other recordkeeping requirements identified in the preceding Chapters.

7.3.3 Guidance for Waste Containers for Interim Storage of GTCC Waste

- The USDOE has responsibility for providing acceptance criteria for containers used to transfer GTCC waste to a Monitored Retrievable Storage (MRS) facility and for disposal of GTCC waste. The availability of written guidance providing this waste acceptance criteria is not known, and it is not anticipated that this will be forthcoming within the next several years.

- The regulations and current guidance documents do not provide any separate design criteria for containers used to store or dispose of spent fuel or GTCC waste.

  - For waste stored in a LLW storage facility other than an ISFSI, refer to the guidelines in preceding Chapters on waste containers for extended storage, including considerations for container corrosion.

  - With regard to storage of GTCC waste in an ISFSI, a survey of decommissioning plants indicates that most are proceeding with the design review for GTCC waste containers using the same criteria applicable to spent fuel storage with additional consideration given to chemical, galvanic, organic or other reactions.

  - *It is incumbent upon the user to ensure that the GTCC waste does not adversely impact on the container, the storage cask, or anything else stored in the ISFSI. [56, 62]*

- The USDOE has already developed several containers which could be used to transfer GTCC waste to an MRS and, subsequently, could be used to store GTCC waste in an ISFSI with a reduced likelihood of repackaging at the end of the storage period. However, these containers have not received final approval from the USDOE and have not been submitted to the USNRC for certification. Therefore:

  - Storage of GTCC waste in any existing container design needs to consider the possibility of repackaging the GTCC waste for final disposal.

  - Such repackaging may occur at the ISFSI, at another appropriately licensed plant processing and packaging area, at an off site vendor facility, or at the final repository. These options should be addressed as part of the long range planning.

- Other GTCC waste containers may be accepted or grandfathered by the USDOE, and decommissioning nuclear plants are using several different container designs. In each case, repackaging prior to disposal remains a reasonable potential.

7.3.4 Guidance for Waste Forms for Interim Storage of GTCC Waste

- For waste stored in a LLW storage facility other than an ISFSI, refer to the guidelines in preceding Chapters on waste forms for extended storage, *including considerations for fire hazards and gas generation.* Remember that:

  - Storage in a LLW storage facility offers greater flexibility for waste containers and waste forms, including those discussed in preceding Chapters. This is especially valuable for waste which is still being characterized and evaluated for further processing.

- If GTCC waste is stored in any container or waste form not discussed in this Chapter, there is a significantly increased probability that the waste will need to be repackaged prior to disposal.

- *Storage of liquid GTCC waste within an ISFSI is prohibited, regardless of whether the ISFSI is operated under a Part 50 general license or a Part 72 specific license. [56, 62]*

- Waste form acceptance criteria for GTCC waste disposal is uncertain at the present time.
  - Nuclear plants which have GTCC resin, filters, or liquid waste may want to postpone any final waste form or waste conditioning decisions until waste acceptance criteria become available.
  - This would require that alternative storage solutions be provided for GTCC liquid waste (e.g., stored in an interim on-site storage facility other than an ISFSI and under the applicable Part 50, Part 30, or Part 70 license).

- *10 CFR Part 72 allows for storage at an ISFSI of solid GTCC waste only (including dewatered resin). [56, 62]*

- Lessons learned from storing dewatered Class A, B and C resin and filter waste demonstrate that dewatered waste accumulates free-standing liquid after even a relatively short period of storage.
  - Although dewatered waste forms may be acceptable for initial short term storage within an ISFSI in accordance with an approved SAR, the dewatering process is typically intended for a period of 90 days prior to disposal. Thus, after a relatively short period, continued storage of dewatered GTCC waste within an ISFSI may lead to a violation of the regulations and ISFSI license.
  - To avoid a violation, monitoring and inspection provisions would need to be made to verify no free-standing liquid in dewatered waste forms (including resin *and* filters), and those inspections—and probable repeated dewatering—would need to be performed at relatively short intervals. The need for such intensive inspection, monitoring, and repeated dewatering requirements suggests that storage of GTCC dewatered waste within an ISFSI is inconsistent with the regulatory intent regarding storing GTCC liquid waste.
  - **RECOMMENDATION:** Thus, it is strongly recommended that alternative storage solutions be provided for GTCC dewatered waste (e.g., stored in an on-site storage LLW facility other than an ISFSI and under the applicable Part 50, Part 30, or Part 70 license). Solidification may become a feasible option in the future within ISFSI container designs—once such design criteria is known—although the need for container solidification internals would significantly impact container design and selection.

- *Other restrictions should be imposed on stored GTCC waste to minimize the potential for chemical, galvanic or other reactions. [56, 62]* Refer to the guidelines and discussions on waste form in Chapters 5.

- *10 CFR 72 prohibits storing Class A, B and C waste in an ISFSI operated under a Part 72 specific license. [56, 62]*

- *An exception is applied to secondary waste generated as part of the routine operation of the ISFSI (e.g., smears, repackaging, spill control, inspection). [56, 62]*
- It should be noted that Part 72 does not allow secondary Class A, B and C waste to be stored within the ISFSI for an extended period. The language of the regulations in Part 72 suggests that such secondary waste should be removed from the ISFSI and dispositioned within an undefined reasonable time frame.

7.3.5 Guidance for Monitoring and inspection of Stored GTCC Waste

Routine monitoring and inspection requirements and associated equipment are needed for ensuring the integrity of waste containers, minimizing occupational exposures, and avoiding uncontrolled releases from an ISFSI. The following guidelines apply:

- General scope of inspections and monitoring:
  - ISFSI – Refer to SAR and license conditions for general monitoring and inspection requirements, in addition to the guidelines specified below.
  - Other LLW storage facilities – Refer to the guidance specified in the preceding Chapters on monitoring and inspection.
- General GTCC waste container inspection frequency:
  - ISFSI – Use the same frequency applied for other ISFSI monitoring and inspection frequencies (refer to SAR and license conditions).
  - Other LLW storage facilities – Replicate frequencies specified in the preceding Chapters on monitoring and inspection, which vary based on waste container selection and waste form.
  - *A physical inventory of GTCC waste containing SNM and stored at the ISFSI must be performed at least once every 12 months, regardless of the storage location. [56, 62]*
- *If dewatered GTCC waste is stored within an ISFSI, monitoring and inspection provisions need to be made to verify there is no free-standing liquid. [56, 62]*
  - Those inspections—and probable repeated dewatering—need to be performed at relatively short intervals (i.e., quarterly).
  - The frequency of inspections can be adjusted after developing an historical trend which supports an extended frequency based on verifications of no free-standing liquid at shorter intervals.
  - Each inspection and, if necessary, dewatering cycle, should be documented and records made available for review.
- *Verify that no Class A, B and C waste is stored in an ISFSI operated under a Part 72 specific license. [v]*
  - *An exception is applied to secondary waste generated as part of the routine operation of the ISFSI (e.g., smears, repackaging, spill control, inspection). [56, 62]*

- Secondary Class A, B and C waste cannot be stored within the ISFSI for an extended period. Verify that such secondary waste is removed from the ISFSI and dispositioned within an undefined reasonable time frame.

7.4 Extended Storage of GTCC Sealed Sources [7]

Disposal is especially difficult for greater-than-Class-C (GTCC) sealed sources. The requirements for classifying waste for near-surface disposal are provided in 10 CFR 61.55. This regulation states that GTCC waste is generally not acceptable for near-surface disposal and must be disposed of in a geologic repository, pursuant to Part 60, unless another disposal method is approved by USNRC. Many sealed source users have discovered that they have no place to ship their GTCC sources for disposal, because no geologic repository is currently available.

The Low-Level Radioactive Waste Policy Amendments Act of 1985 designates the Federal Government as responsible for disposal of GTCC wastes. Congress has designated the Department of Energy (DOE) as the responsible agency for disposal of GTCC waste, however related guidance has not yet been issued by the DOE. It should be noted that DOE efforts to recover GTCC, particularly high activity sources, has been exceptionally successful in recent years.

7.4.1 Guidance for Storing GTCC Sealed Sources

The following information should be maintained relative to GTCC sealed sources:

- *Identification of each sealed source to be placed in storage, including the manufacturer's name, model number, serial number, isotope, and activity. [7]*
- *A description of the accountability program to be implemented by the licensee to ensure that its sources remain in secure storage and are not used. The program should provide reasonable assurance that the licensee can maintain security and account for the sources (inventory at least annually). [7]*
- *A commitment to leak-test the sources at least once every 3 years and immediately before transfer to an authorized recipient. [7]*

7.5 Storage of Fuel Assembly Integral Components in an ISFSI [56]

Title 10, Code of Federal Regulations (10 CFR), Section 72.3, "Definitions," states, " *Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies.*" Therefore, such materials are not GTCC waste and should be stored in accordance with regulations for spent fuel. Spent fuel storage is beyond the scope of this Guidance document.

8
END OF STORAGE GUIDELINES AND CONSIDERATIONS

Lessons learned from extensive utility low level waste (LLW) storage experience have been translated to guidance for the end of the storage period. This Chapter also provides a discussion of related experience.

8.1 Guidance for End of Storage

- At the end of the storage period, inspect and repair all support utilities and equipment used to inspect, handle, repackage, or reprocess waste (e.g., lighting, crane, drains).
- *All wet solid LLW in interim storage will require additional reprocessing before shipment offsite. [1]*
  - Industry experience supports this USNRC guidance as being applicable to waste stored for as little as 90 days.
  - As a minimum, each wet solid LLW package should be evaluated to verify it meets the waste acceptance criteria for disposal prior to shipment offsite, with special attention given to the amount of free-standing liquid.
  - Determine if waste meets Waste Acceptance Criteria (WAC) for intended disposal facility (may be different from originally planned facility or WAC); repackage and reprocess as necessary. (Some countries refer to WAC as "conditions for acceptance (CFA).")
- Determine if the waste acceptance criteria for the intended disposal site has changed since the time the waste was placed in storage.
- Determine which wastes or packages meet the waste acceptance criteria for disposal for the intended disposal facility.
- Where practical, pursue a first in/first out approach (oldest waste should be considered for first disposal).
  - Verify the storage documentation matches the container selected for removal.
  - Assess the radiological conditions of all waste packages.
  - Reevaluate waste characterization as needed to ensure waste classification.
  - Perform decay analyses to identify the current nuclide concentrations.
- Verify the processed and stored waste meets the process control program (PCP) criteria in effect at the time of shipment to disposal (e.g., free-standing liquid). This involves a

review of the disposal site waste acceptance criteria and the standards applicable to the PCP in effect at the time the waste was originally processed.

- Inspect for degradation of waste containers, including oxidation (rust), leaks, or visible damage (e.g., punctures, container swelling).
- For wet solid LLW (e.g., resin, filter cartridges), verify no free-standing liquid.
- For solidified LLW, verify no free-standing liquid (e.g., rain, dew) on top of the monolith inside the container.
- If it is a condition of disposal, verify that no excessive void spaces exist in waste containers which were stored without volume reduction conditioning. (Unprocessed waste can undergo subsidence within the waste container.)
- Inspect rigging, grapples, lifting eyes, attaching points, etc. to ensure they still meet the applicable serviceability criteria. This includes both the crane rigging and any permanent attachments to the waste container/package. Replace as necessary.
- Evaluate the internal waste impact on containers (e.g., corrosion, H_2 and CH_4 generation).
- Evaluate changes in USDOT shipping restrictions (typification, labeling, IP requirements) which may require re-labeling or even repackaging.
- Evaluate changes in hazardous waste regulations which might indicate conversion from a LLW to a mixed waste.

8.2 End of Storage Considerations

1. Waste settling during storage can create excessive void spaces (frequently >15%) for some waste packages. This applies primarily to nonmetal wastes which were placed in storage without volume reduction processing. This must be identified and, where necessary, the waste should be reprocessed and/or repackaged to meet the WAC.

2. Many plants which experienced one or more periods of interim, extended storage provided feedback on lessons learned at the end of the storage period while preparing to ship waste for disposal. Repackaging was not particularly common, although reprocessing (dewatering) of previously dewatered resins and filters was common. The following insights were provided from a nuclear plant which experienced an 18-month interim storage period following the closure of Barnwell in 1994/95:

   - Five wet waste containers were placed in storage: four with resin; one with filters. At the time, polyethylene high integrity containers (HICs) were the most common storage approach in the USA. Resin solidification was not practical at that time, and there was no nationally approved binders for filter encapsulation. Moreover, design restrictions inherent to the local storage facility (restrictive sizing of high activity storage vaults) precluded storage in commercially available ferralium HICs.

   - The high activity storage vaults are designed for storage of 80 ft^3 containers. Because that is an unusual container size, they are exceptionally expensive.

- The plant fire protection staff required that all polyethylene HICs be placed in metal overpacks (as experienced at other plants, both in the USA and internationally), which further increased storage costs per container.

- All resin was dewatered, *but the dewatering equipment test report was only valid for 90 days*. After that period, the residual water content within the container was no longer certified to meet disposal criteria. This meant the plant would have to verify that no free-standing water was present before shipment for disposal.

- The plant arranged with the HIC supplier to install a separate dewatering verification tube with a stone filter at the bottom of the HIC. A connecting tube could be easily attached to a fitting in the cover plate of the HIC under the plastic lid, allowing for any free-standing water to be removed without the use of a fill head. This was an excellent pre-planning approach which reduced labor time and some of the associated radiation exposures for removing any residual water.

- Of the four resin HICs placed in storage, three exceeded the free water criteria when removed from storage. The entire process of verification and removal of any free-standing water was both labor intensive and dose intensive. Each metal overpack had to be opened, the plastic HIC lid was removed, the dewatering tube was attached, and the HIC dewatered. The polyethylene HICs also were removed from the metal overpacks and shipped separately for disposal to reduce disposal costs. The entire process from storage removal to shipment averaged one week per stored waste container.

- Filters were stored within a HIC with a suspended encapsulation basket. They had not been cement-encapsulated, as no nationally approved cement binder existed at that time. However, since some of the filters contained a cellulose matrix, a potential existed for gas generation. If gas generation had become a problem, the container could have been filled with cement to mitigate the problem.

- Upon removal of the filter HIC from storage, water could be heard sloshing in the bottom of the container. It was estimated that several inches of water were present in the container, and it was solidified with cement prior to disposal.

- The quantifiable impact to the plant for removing, dewatering, and preparing these five containers for disposal was an extra $40,000 per container and an extra 420 mrem per container. The plant estimates that all of these costs and the associated dose could have been avoided if the waste had been solidified prior to storage.

- The plant also removed a sixth container which had been in storage for more than two years. This was an empty metal liner. Although the container was indoors with its lid secured in place, approximately one inch of water was found inside the liner. The liner had a passive vent, and the plant believes that moisture entered the liner via the passive vent. Thus, the source of the water was dew formation on the walls of the container. Again, this emphasizes the need for verifying the absence or presence of free-standing water in wet waste packages prior to shipment. It also highlights the potential benefits of solidification prior to storage.

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