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## SUMMARY OF FLUORIDATION / FLUORIDE INCIDENTS

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### GENERAL

When communities fluoridate their drinking water, a potential always exists for a fluoride overfeed. Although most overfeeds are of no serious consequence and do not increase the risk of any adverse health effects, they should be taken seriously and corrected immediately.

For the purpose of this summary, the following definitions are used:

- I. A fluoridation overfeed incident with illness is when, due to a fluoridation equipment malfunction, a fluoridation equipment or system design flaw, or operator error, there is a fluoride concentration of 4 mg/L, or above, (7.0 mg/L in school systems) in the distribution system and there are one or more reported illnesses or hospitalizations.
- II. A fluoridation overfeed incident without illness is when, due to a fluoridation equipment malfunction, a fluoridation equipment or system design flaw, or operator error, there is a fluoride concentration of 4 mg/L, or above, (7.0 mg/L in school systems) in the distribution system and there are no reported illnesses or hospitalizations.
- III. A fluoridation non-overfeed incident is when, due to a fluoridation equipment malfunction, a fluoridation equipment or system design flaw, or operator error, there is a fluoride concentration of less than 4 mg/L (less than 7.0 mg/L in schools), but above the recommended control range for the water supply system in the distribution system. [Fluoride concentration varies between 1.4 and 4.0]
- IV. A fluoridation-related industrial accident is when a mishap occurs at or near the water treatment plant or water well site, which involves fluoride chemicals.
- V. Other fluoride-related incidents are when events occur that do not relate directly to water fluoridation, but do involve some form of the element fluorine.

Distinction should be made among the above five categories, with regard to the reporting of each incident:

Category I, fluoridation overfeed incident with illness, is a reasonably complete summary, as most events that cause illness such as these will receive attention and, especially if serious, will be documented in the literature.

In the summary of Category II, fluoridation overfeed incident without illness, information obviously will be much less complete.

The total number of incidents in Category III, fluoridation non-overfeed incidents, is really unknown. The incidents in Category III are included simply because these events have been brought to our attention.

The total number of incidents in Category IV, fluoridation-related industrial accident, is unknown. There are times when accidents occur that will involve fluoride equipment or chemicals, but are not directly related to water fluoridation. For example, a spill could occur when a bulk acid storage tank ruptures. As a result, the ground water in the area might be affected adversely. This type of accident will have no effect on the level of fluoride in the drinking water. Summaries of these accidents are included, when known, because the details of these accidents are sometimes misrepresented.

The total number of incidents in Category V, Other fluoride-related incidents, is clearly far from complete. These incidents, primarily fluoride poisoning, are documented in the literature as far back as 1899. There is no attempt to try to include all the known incidents, only those that are recent or have sparked national interest. Many scientific articles and books are available for a much fuller summary of the events in this category.

The incidence of **reported** overfeeds in this country since the beginning of fluoridation in the 1940's has been quite infrequent and has only been documented by State or Federal officials since the middle 1960's. The Centers for Disease Control and Prevention (CDC) has been a major source of documentation on reported overfeed incidents on a voluntary, informal basis since 1979.

Conceivably, all fluoridated water systems, including communities and schools, can experience overfeeds. However, an occurrence in a rural school system would have the greatest potential for serious health effects because of the higher fluoride levels maintained (4.5 times optimum); smaller distribution system; physical size of the people involved (low body weight); and generally the operator's lower level of technical expertise. The major concern is that a "slug" of very high fluoride concentration in the water could cause acute fluoride poisoning.

With overfeeds, there are three important points to remember. First, the number of reported overfeed incidents with illnesses is small when compared to the number of systems that are fluoridating. Second, the effects resulting from an acute overdose of fluoride are usually mild and short-lived. Finally, it is very difficult to ingest fluoride in large enough quantities to make a person seriously ill. For example, one of the symptoms of acute fluoride poisoning is severe nausea; thus, in effect, people usually "cure" themselves by vomiting.

The following is a summary of each reported fluoride incident:

## TABLE I – SUMMARY OF OVERFEED ILLNESSES & DEATH

Note: This Table is not an official part of this Summary of Fluoridation/Fluoride Incidents report of 9/1/98. It was added to consolidate information from other portions of the report to facilitate review. It should be noted that this is the best information available and there could well be other unreported incidents and illnesses. The Centers for Disease Control and Prevention (CDC) has been the major source of documentation on reported overfeed incidents on a voluntary, informal basis since 1979.

### I-A OVERFEED INCIDENTS WITH ILLNESS IN COMMUNITY WATER SYSTEMS

<u>LOCATION</u>	<u># ILLNESSES</u>	<u># DEATHS</u>	<u>PG#</u>
1. Harbor Springs, Michigan	4	0	6
2. Island Falls, Maine	6	0	6
3. Annapolis, Maryland (dialysis patients)	8	1	7
4. Crownpoint, New Mexico	35-40	0	7
5. North Branford, Connecticut	1	0	8
6. Westby, Wisconsin	5	0	8
7. Rice Lake, Wisconsin	4-5	0	9
8. Hooper Bay, Alaska	260	1	10
9. Poplarville, Mississippi	32	0	10
10. Caravel Farms, Delaware	"Small number of people"	0	11
11. Pacific Missile Range Facility, Kekaha, Kauai, Hawaii	9 (16 exposed)	0	11
12. Fisher, Illinois	5-6 w/ several children	0	12

### I-B OVERFEED INCIDENTS WITH ILLNESS IN SCHOOL WATER FLUORIDATION SYSTEMS

1. Bradford County, Pennsylvania	150-600	0	12
2. Stanly County, North Carolina	213	0	12
3. Los Lunas, New Mexico	34	0	13
4. Marshall County, Indiana	6-7	0	13
5. Whitley County, Kentucky	12 + several teachers	0	13
6. Shaftsbury, Vermont	22	0	14
7. Jonesboro, Maine	37	0	14
8. Hamilton County, Indiana	Several children	0	15
9. Harlan County, Kentucky	Many children	0	15
10. Duplin County, North Carolina	6	0	15
11. Elkhart County, Indiana	Several Children	0	16
12. Franklin County, Vermont	36	0	16

### V- OTHER FLUORIDE-RELATED INCIDENTS

1. McKinney, Texas (polydipsia)	0	1	38
20. Chicago, Illinois (dialysis patients)	Several	3	44

Comment: On Pg. 2, the CDC states that one of the symptoms of acute fluoride poisoning is severe nausea and people usually "cure" themselves by vomiting. What is not pointed out is that the fluoride in contact with strong stomach acids turns to hydrogen fluoride (HF), which is highly corrosive and deadly. The vomiting is only a reaction to possible severe damage being done to the stomach lining. No followup studies for permanent stomach damage was noted in the reports.

Prepared: 12/23/00

Pg 3a (Insert)

## **BRIEF SUMMARY**

### **I-A. Overfeed incidents with illness in community water systems. - PAGE 6**

There have been 12 reported community overfeed incidents with illness:

1. Harbor Springs, Michigan - November, 1977
2. Island Falls, Maine - May., 1979
3. Annapolis, Maryland - November, 1979
4. Crownpoint, New Mexico - May, 1983
5. North Branford, Connecticut - March, 1986
6. Westby, Wisconsin - September, 1990
7. Rice Lake, Wisconsin - February, 1992
8. Hooper Bay, Alaska - May, 1992
9. Poplarville, Mississippi - August, 1993
10. Caravel Farms [Glasgow], Delaware - September, 1993
11. Pacific Missile Range Facility [Kekaha], Hawaii - October 4, 1993
12. Fisher, Illinois - September, 1994

### **I-B. Overfeed incidents with illness in school water fluoridation systems. - PAGE 12**

There have been 12 reported school overfeed incidents with illness.

1. Bradford County, Pennsylvania - June, 1972
2. Stanly County, North Carolina - April, 1974
3. Los Lunas, New Mexico - November, 1978
4. Marshall County, Indiana - April, 1979
5. Whitley County, Kentucky - November, 1979
6. Shaftsbury, Vermont - August, 1980
7. Jonesboro, Maine - October, 1981
8. Hamilton County, Indiana - January, 1982
9. Harlan County, Kentucky - March, 1982
10. Duplin County, North Carolina - September, 1982
11. Elkhart County, Indiana - September, 1985
12. Franklin County, Vermont - October, 1985

### **II-A. Overfeed incidents without illness in community water systems. - PAGE 17**

There have been 24 reported overfeed incidents without illness in community water systems.

1. Stanford University [San Francisco], California- November, 1976
2. Marin County, California - October, 1977
3. St. Charles, Minnesota - August, 1978

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### **I-B. Overfeed incidents with illness in school water fluoridation systems. - PAGE 12**

There have been 12 reported school overfeed incidents with illness.

1. Bradford County, Pennsylvania - June, 1972
2. Stanly County, North Carolina - April, 1974
3. Los Lunas, New Mexico - November, 1978
4. Marshall County, Indiana - April, 1979
5. Whitley County, Kentucky - November, 1979
6. Shaftsbury, Vermont - August, 1980
7. Jonesboro, Maine - October, 1981
8. Hamilton County, Indiana - January, 1982
9. Harlan County, Kentucky - March, 1982
10. Duplin County, North Carolina - September, 1982
11. Elkhart County, Indiana - September, 1985
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### **II-A. Overfeed incidents without illness in community water systems. - PAGE 17**

There have been 24 reported overfeed incidents without illness in community water systems.

1. Stanford University [San Francisco], California- November, 1976
2. Marin County, California - October, 1977
3. St. Charles, Minnesota - August, 1978

4. Fenton, Michigan - May, 1979
5. Nisqually Indian Reservation, Washington - September, 1980
6. Potsdam, New York - August, 1981
7. Alameda County, California - February, 1982
8. Henry County, Illinois - August, 1988
9. Scioto County, Ohio - September, 1988
10. Arnold, Maryland - November, 1988
11. Bayfield, Colorado - December, 1988
12. Southington, Connecticut - December, 1989
13. Hagerstown, Indiana - Mach., 1990
14. Galax, Virginia - May, 1990
15. Florence, South Carolina - May, 1991
16. St. Frances, South Dakota - August, 1992
17. Sarnia, Ontario - January, 1993
18. Highland Falls, New York - May, 1993
19. Middletown, Maryland - November, 1993
20. Longmont County, Colorado - October, 1994
21. Coalton, West Virginia - August, 1994
22. Stockton, Missouri - August, 1995
23. Bois Forte Reservation, Minnesota - October, 1997
24. Duncan Falls, Ohio - January, 1998

II-B. **Overfeed incidents without illness in school water fluoridation systems.** - PAGE 27

There has been 1 reported school overfeed incident without illness.

1. Hamilton County, Indiana - May, 1989

III. **Fluoride non-overfeed incidents** - PAGE 28

There have been 7 reported fluoride non-overfeed incidents in community water systems.

1. Marysville, Michigan - November., 1983
2. Lake County, Ohio - June, 1986
3. Martinsville, Virginia - July, 1987
4. Emporia, Virginia - November, 1987
5. Cambridge, Ohio - July, 1992
6. Marin County, California - July, 1992
7. Snowmass Village, Colorado, October, 1997

IV. **Fluoride-related industrial accidents** - PAGE 31

There have been 19 reported fluoride-related industrial accidents.

1. Lebanon, Pennsylvania - August, 1975
2. Seattle, Washington - May, 1976
3. Syracuse, New York - Mach, 1977
4. El Rito, New Mexico - June, 1978
5. Pendleton, Oregon - June, 1981
6. Benton, Arkansas - July, 1982
7. Charleston, South Carolina - January, 1984
8. Pendleton, Oregon - November, 1984
9. Greenville, South Carolina - December, 1984
10. Charleston, Illinois - August, 1985
11. Las Vegas, New Mexico - March, 1986
12. Schenectady, New York - January, 1988
13. New York City, New York - July, 1988
14. Winnipeg, Manitoba - January, 1989
15. Burlington, North Carolina - September, 1991
16. Cartersville, Georgia - December, 1992
17. Springfield, Illinois - May, 1993
18. Burlington, Massachusetts - May, 1994
19. Bridgeport, Texas - August, 1994

V. **Other fluoride-related incidents** - PAGE 38

There have been 24 reported other fluoride-related incidents.

1. McKinney, Texas - 1962
2. Brooklyn, New York - May, 1974
3. New Haven, Connecticut - 1974
4. Baltimore, Maryland - 1979
5. Denver, Colorado - 1979
6. Vienna, Austria - 1982
7. Raleigh, North Carolina - January, 1983
8. San Diego, California - 1985
9. Fairfax, California - August, 1985
10. Gore, Oklahoma - Jan., 1986
11. Fort Totten, North Dakota - April, 1986
12. Galax, Virginia - September, 1986
13. Old Ocean, Texas - October, 1988
14. Virginia, 1988
15. Virginia, 1988
16. Annapolis, Maryland - July, 1989
17. Argentina - August, 1991
18. Hennepin County, Minnesota - 1991
19. Marshall, Minnesota - 1992
20. Chicago, Illinois - July, 1993
21. Edgecombe County, North Carolina - October, 1993

22. New York City, New York - July, 1994
23. Deltona, Florida - September, 1994
24. Tokyo, Japan - March, 1995

## I-A. OVERFEED INCIDENTS WITH ILLNESS IN COMMUNITY WATER SYSTEMS

### 1. Harbor Springs, Michigan, 1977

On November 22, 1977, four persons in Harbor Springs (pop. 1,700), became ill with nausea and vomiting shortly after drinking municipal water. Only one person sought medical assistance and he was hospitalized overnight. Everyone was reported to be all right within 3 days. An investigation by local, state, and Federal personnel indicated that these persons probably had experienced acute fluoride poisoning.

The mechanical control of the fluoride metering pump at one of the city's four wells had malfunctioned, and a large slug of 25 percent fluorosilicic acid ( $H_2SiF_6$ ) had been injected into the discharge line of a reserve well. Concentrated acid went into the municipal water system when the reserve well was activated. The highest reported level of fluoride was 42.6 ppm in town. The problem of explaining the overfeed was greatly complicated by the fact that state and Federal health officials decided to simulate the overfeed with the chloride ion. This simulated test produced chloride concentrations as high as 2,400 ppm in town, but there was no real relationship between the overfeed and the simulated test.

### 2. Island Falls, Maine, 1979

On May 2, 1979, the Bureau of Health in Maine was informed that 2 gallons of fluorosilicic acid ( $H_2SiF_6$ ) had been injected inadvertently into the Island Falls water system. Island Falls is a small town in northern Maine with a population of 1,010. On the morning of May 2, the water plant superintendent had changed a flow meter in a large water pipe within the pump house near the point that the fluoride line entered. In order to change this meter, he had shut off the pump and closed the valves on either side of the meter. (The fluoride line enters the main water pipe between these two valves next to the meter.) Once the meter had been changed, he opened both valves and turned the pump back on. It was theorized that pulling out the old meter had created negative pressure within the isolated segment of pipe and sucked in the  $H_2SiF_6$  solution. There was no anti-siphon device in the fluoride feed line.

Water was sampled for fluoride at various points in the system. Two residents were interviewed, and a telephone survey was conducted to search for cases of acute fluoride toxicity. Six possible cases were identified. The highest level of fluoride found was 250 mg/L in a cup of coffee. It was concluded that a few people in Island



Falls had acute gastrointestinal symptoms due to fluoride intoxication on May 2, though this conclusion is not definitely provable. There were only these few reported illnesses and no hospitalizations.

### 3. Annapolis, Maryland, 1979

\* It was reported that a fluoride accident occurred at Annapolis on November 11, 1979. Apparently eight patients undergoing kidney dialysis at a local clinic became ill. Two patients were very ill, one of whom died. The fluoride level in the water at the dialysis clinic was 35 ppm and was the highest level of fluoride reported. Several thousand cases of Pepsi Cola Products were destroyed because they were found to have a fluoride level of over 5 ppm. No other individuals within the community appeared to have been affected by the accident.

On the morning of November 11, it was discovered at the water plant that a valve which normally controls the flow of fluorosilicic acid ( $H_2SiF_6$ ) from a large 4,000 gallon storage tank to an intermediate containment tank was left open all night. This allowed an estimated 1,000 gallons of acid to overflow the 50-gallon containment tank into a floor drain. The floor drain emptied into one of two recycling backwash ponds, thus the acid reentered the plant treatment process as recycled decant from filter backwashes.

Several factors greatly complicated this accident. First, EPA required that all waste water discharges to receiving streams be disconnected (PL-92-500), thus the backwash waste water line (which also included the plant floor drain lines) was diverted from the stream to ponds. The water from the ponds was recycled back to the head of the water plant. The floor drain was, in effect, cross-connected to the raw water supply. Second, the manual valve was left open all night by water plant employees. Third, the fluoride was not serially tested when the fluoride testing meter "pegged" at 2.0 ppm on their colorimetric tester. Fourth, there was a breakdown and delay in the reporting procedures. While the spill occurred on November 11, the state and county health officials first learned about it on November 20. Also, the recommended treatment (deionization/reverse osmosis) of the water for preparation of dialysis was not adhered to at the kidney dialysis center. And, finally, the patient who eventually dies, refused hospitalization for observation. He died on November 14, 3 days after the original incident. The autopsy report stated that the immediate cause of death was hypertension and arteriocardiovascular disease, with a contributing cause of death of acute fluoride intoxication during hemodialysis.

### 4. Crownpoint, New Mexico, 1983

Crownpoint is a village on the Navajo Indian Reservation. The tribe operates the water supply system for Crownpoint. The water system consists of two wells with fluorosilicic acid ( $H_2SiF_6$ ) and gas chlorine being fed at each well. An overfeed was

reported on or about May 23, 1983.

The cause of the overfeed is still unknown, but there are two theories. First, one of the wells was undergoing maintenance. The master meter was removed and cleaned. A flush valve was installed between the well pump and the fluoride injection point. The flush valve would discharge waste water from acid cleaning of the well and the well screen. When the well was operated to "flush" out the cleaning acid in the well, the fluoride metering pump may have remained electrically connected. Thus, the well discharged water to waste and the fluoride metering pump fed a slug of water into the nonflowing main water line, creating a large "slug" of high fluoride in the water.

The second theory is that the fluorosilicic acid carboy was sitting higher than the fluoride injection point. When the master meter was removed, a particle vacuum was created in the water line, and if the anti-siphon device on the fluoride metering pump failed, then a slug of acid could have siphoned into the water line.

Thirty-five to 40 people in the area of one of the wells were reported to be ill with nausea, vomiting, dizziness, diarrhea, skin rash, and eye irritation. These problems cleared up quickly, and no one was hospitalized. The fluoride content of the water was analyzed, and fluoride levels from 60 ppm to 208 ppm were found. The pH of the water was 4.0 to 4.5. Tribe officials questioned the fluoride test results because of the low pH and high sulfate in the water. The eye irritation and skin rashes were reported by people who had just taken showers.

#### 5. North Branford, Connecticut, 1986

On March 12, 1986, a fluoride overfeed occurred in the water system located at North Branford, Connecticut. The system serves approximately 400,000 people, including New Haven and 11 other communities. The overfeed occurred from 2:00 a.m. to 4:00 a.m. when a change in plant operation was made. Several water lines were switched and inadvertently, the fluoride injection point was relocated from a large water line to a smaller line. The pacing meter was left in the larger line. Then 70 gallons of fluorosilicic acid were fed by the pacing meter into the small water line, which served approximately 150 homes. The highest recorded level of fluoride was 50 ppm. The city flushed the area water lines and the service water lines where the 150 homes were located. One case of illness was reported.

#### 6. Westby, Wisconsin, 1990

Over the weekend of September 22, 1990, a fluoride spill [overfeed] occurred in the Westby Public Water Supply System resulting in 5 people becoming ill. A check valve had become stuck in the closed position in one of the city wells. The fluoride metering pump kept on pumping fluoride chemical into the water line resulting a slug of high fluoride content. The homes served by this well were on a dead end water line. The fluoride concentration in the water line outside the wellhouse was

144 mg/L. One half mile away the fluoride concentration in the drinking water was only 1.7 mg/L.

Five people had become sick with diarrhea, vomiting and abdominal pains. One lady across the street from the wellhouse went to see her physician. No one was hospitalized and all were alright within a few days. The problem in the wellhouse was corrected and fluoridation was resumed.

7. **Rice Lake, Wisconsin, 1992**

Between February 22 and 23, 1992, a fluorosilicic acid overfeed occurred in Rice Lake, Wisconsin. The city uses several wells as their source of water. At well No. 5 the anti-siphon device in the fluoride feed line malfunctioned allowing 20 gallons of 23% acid to be siphoned into the water system. Apparently, small pieces of plastic from the threads of the anti-siphon valve chipped off and became lodged in the valve spring or beneath the valve diaphragm, allowing the acid to siphon into the well discharge piping when reduced pressure occurred in the system. There was no second anti-siphon device in the feed line, nor was there any utilization of day tanks at any well house.

The actual high fluoride level in the distribution system is unknown because the overfeed occurred on the weekend and no water samples were taken. Corrections were made in the system and it continues to fluoridate.

Approximately 150 customers lived within the affected area. Ten customers noticed something wrong with the water and 4 to 5 people were reported to be ill. No one was hospitalized.

8. **Hooper Bay, Alaska, 1992**

In May 1992, an outbreak of acute fluoride poisoning occurred in Hooper Bay, Alaska (population 845), a small Indian Village located on the western coast of the Yukon-Kuskokwin Delta. This outbreak resulted in widespread illness among people residing in the townsite section of the village and the tragic death of one resident.

Hooper Bay residents obtain water from three separate wells in the village--the townsite well, the housing-site well, and the school well. The three water systems are completely separate, with no plumbing connections. Water from each well is fluoridated with sodium fluoride, using a saturator. Investigation of the townsite well identified mechanical problems that may have contributed to or caused the water system's malfunction. Water that had been collected from the townsite well by village residents was tested. Fluoride concentrations of water collected on May 14, 20, and 21 were 5.1, 2.0, and 150.0 ppm, respectively. The well was reportedly turned off on May 23. On May 26, the fluoride concentration of water in the holding tank at the well was 61.0 ppm. There is no evidence that water sources other than the townsite well had elevated levels of fluoride or any other chemical. Approximately 90 people reported becoming ill between May 20-24; (although, a

\* later household survey said approximately 260 people became ill.) The symptoms consisted primarily of nausea, vomiting, and abdominal pain. One person was hospitalized and one person died (a 41 year old male). Almost all of the persons reported becoming ill shortly after consuming water that had been drawn from the townsite well on May 21 or 22. The person who died became ill on May 22 and died 18-24 hours later, after consuming a large quantity of water from the townsite well.

While the exact sequence of events that caused the elevated fluoride concentration in the system may never be accurately determined, it is likely that all or some of the following factors were contributors:

- a. The Alaska Department of Environmental Conservation indicated that no reports of fluoride levels had been sent by the water system operator to the state for almost two years.
- b. High fluoride levels had been noted three times prior to the outbreak.
- c. When elevated fluoride levels were discovered in early May, recommendations from the Indian Health Service for correction were given to the water plant operator. Apparently, these corrections were not implemented. Despite recommendations to unplug the fluoride pump on May 6, evidence indicates that as late as the morning of May 26, the fluoride pump was still operative.
- d. Hooper Bay had been without a city administrator for a year; thus, communications and assurance of compliance with recommendations were difficult.
- e. Poor maintenance of bulk chemicals caused corrosive damage to the electrical system and may have resulted in a malfunction of the well pump.
- f. The fluoride metering pump was wired in parallel, rather than in series with the water pump, allowing the fluoride pump to run for an extended period of time in the absence of water flow. A malfunction of the relay allowed the fluoride pump to turn on when the water pump remained off.
- g. The fluoride metering pump may have malfunctioned, pumping at a rate over seven times higher than normal. (The fluoride pump was oversized.)
- h. When the drop pipe hose bibb was open, there was nothing to prevent backflow into the well. The hose connected to the drop pipe could be used to fill the fluoride storage tank, thus setting up a cross connection.
- I. The water system operator had no formal training and apparently did not recognize the significance of the problems that led up to the outbreak.

The city has not resumed fluoridation and has no plans for doing so.

Ninety people were ill and one death occurred.

## 9. Poplarville, Mississippi, 1993

On August 10, 1993, a fluoride overfeed occurred in Poplarville, Mississippi, resulting in 32 illness [14 with acute gastrointestinal upset in a Pizza Hut restaurant]. Fifteen people went to the hospital but did not stay overnight. One household next to the water plant had a tap water sample containing 200 ppm of

fluoride. At the restaurant, the fluoride in the tap water samples ranged from 35 to 40 ppm.

The overfeed occurred when the water plant was shut down for maintenance and the clear well was drained. A faulty anti-siphon device on the sodium fluoride saturator was allowing the fluoride chemical to siphon back into the clear well, evidently for a long period of time. But the problem was not discovered until the water plant shut down and the fluoride chemical siphoned into the empty clearwell. When the plant went back in operation the fluoride "slug" entered the distribution lines and an overfeed occurred. The city had not been doing daily testing for fluoride. The city resumed fluoridation after the problem was fixed.

**10. Caravel Farms [Glasgow], Delaware, 1993**

On September 28, 1993, following a strong afternoon storm from the previous day, a fluoride overfeed occurred in the water distribution lines of the Artesian Water Company near Glasgow. The "slug" of fluoride was confined to the Caravel Farms area, primarily the Hickory Woods subdivision. Mechanical failures (faulty solenoid valve and a failed check valve in the main water line from the well) at the Caravel Farms station allowed the back siphoning of a storage tank containing approximately 40 gallons of fluorosilicic acid directly into the well. Upon restarting the pumping station (the well turned on), the high concentration of fluoride from the well was pumped directly into the distribution system. The affected lines were flushed and after corrections were made, water fluoridation was restarted. A "small number of people" reportedly become ill. No one was hospitalized. The level of fluoride at its highest point was not reported.

**11. Pacific Missile Range Facility [Kekaha] Hawaii, 1993**

On October 4, 1993 an overfeed was reported on the Pacific Missile Range Facility [PMRF] near Kekaha, Hawaii. The military purchases water from the municipal water system [wells] of Kekaha and adds fluoride chemical prior to storage. The water line extends westward from the community water system, passes under a dump site to the PMRF water system. The fluoridated water in the storage tanks is pumped into the PMRF water system to supply water to the PMRF residents. On October 3, a water line break occurred east of the PMRF and dump site. During the water line break, fluoride was leaking in the water line east of the dump site. Workmen employed by the city of Kekaha at the dump site drank the water on October 4 th, just prior to the water line being repaired. Sixteen people were exposed, with 9 people becoming ill. The fluoride level was 220 ppm in the water sample taken at the site just before the repair was completed. PMRF resident were not exposed to excess levels of fluoride. There was no anti-syphon valve on the fluoride feed line.

**12. Fisher, Illinois, 1994**

On September 26, 1994, an overfeed was reported in the small town of Fisher. The Watts anti-siphon device on the upflow sodium fluoride saturator crystallized and stuck open (failed) and a high concentration of fluoride got into the main distribution line. The city tested the water and got ranges from 12 to 15 ppm of fluoride, but it is believed that they missed the highest level of the "slug" of fluoride. Five to six people reported a mild illness and there were no hospitalizations. The city resumed fluoridation after correcting the problem. The city superintendent said that they installed an air gap in the incoming water line. (It is not sure how this was accomplished with an upflow saturator.) Four days after the overfeed incident, several children in an after school care program in Fisher complained that they were sick from "fluoride poisoning" but the city test's results showed less than 2 ppm of fluoride in the water.

**I-B. OVERFEED INCIDENTS WITH ILLNESS IN SCHOOL WATER FLUORIDATION SYSTEMS**

**1. Bradford County, Pennsylvania, 1972**

On June 6, 1972, at the N.E. Bradford County Elementary School picnic, between 150 and 600 children experienced nausea and vomiting. This school is located near Rome, Pennsylvania. No one was sent to the hospital. The cause of the vomiting was traced to the high fluoride level in Koolaid drunk by the children. The water for the school was supplied by a well and fluoridated with sodium fluoride. Analysis showed that the drinking water contained 67 ppm of fluoride. An investigation revealed that a school employee (operator) had "felt that the fluoride level in the water was not high enough and had run the fluoride metering pump while the water supply was shut off." No further information is available on this incident.

**2. Stanly County, North Carolina, 1974**

On April 16, 1974, 201 students and 12 adults at a rural grammar school in Stanly County became ill within minutes after drinking orange juice at a morning recess. The orange juice contained 270 ppm of fluoride. A sample of drinking water had a fluoride concentration of 125 ppm. All 213 individuals experienced nausea, and all 201 students (age 6-12) and 7 of the 12 adults vomited. No one had fever, abdominal cramps, or diarrhea. The symptoms lasted from 15 to 60 minutes; no one was hospitalized.

The school's water is supplied by a well and fluoridated with sodium fluoride from a saturator. In the month prior to the outbreak, the water pump had been operating only intermittently, and the week prior to the outbreak, while school was closed for the Easter holidays, the fluoride metering pump malfunctioned. This caused sodium fluoride solution to be fed into the water system continuously while the water pump

was not operating. There was a flow switch in the water line, but it also malfunctioned (it was stuck open). Since this incident, North Carolina has installed two flow switches in all their school fluoridation systems.

3. Los Lunas, New Mexico, 1978

On the morning of November 17, 1978, 31 students and 3 teachers at an elementary school in Los Lunas became ill with common symptoms that included nausea, vomiting, and abdominal pain or cramping. The water was reported to taste bitter and salty. By early afternoon, the state laboratory had reported that fluoride levels in water samples taken from two different drinking fountains in the school were significantly elevated (375 and 93 ppm). No one was sick enough to see a physician or be hospitalized. Two-thirds of the affected persons were well within 24 hours, and all were well within 72 hours.

The school obtains water from a well on the school grounds. Since March 1976, the water had been fluoridated using a batch mix of sodium fluoride (unsaturated solution - 4,220 ppm). The well pump and fluoride metering pump were turned on simultaneously by a relay switch when pressure in the storage tanks decreased. This relay switch malfunctioned, causing the fluoride metering pump to operate by itself, resulting in an overfeed.

4. Marshall County, Indiana, 1979

On April 20, 1979, a high fluoride level was reported at the West Elementary School in Marshall County. On April 19, a water line entering the building had ruptured, preventing the maintenance of the correct proportion of well water to saturated fluoride solution. No flow switch had been installed.

Six or seven children were affected, with three children vomiting. The water tasted salty and was found to have a fluoride content between 300 and 1800 ppm. No one was hospitalized, and everyone was all right within 24 hours. The problem was corrected and a flow switch was added to the water line.

5. Whitley County, Kentucky, 1979

On the morning of November 7, 1979, 12 students and several teachers of the Nevisdale Elementary School became ill after drinking school water, orange juice, and/or coffee. Headaches, stomach cramps, and vomiting were symptoms of the illness. The school water was tested and found to contain 60.8 ppm of fluoride. There were no reported visits to a physician or hospital by the persons who were ill. All were well within 24 hours.

The school water was supplied by a well. The fluoride metering pump, using sodium fluoride from a saturator, was wired in series with the well pump and two in-line flow switches. On the morning of November 7, the water well pump burned out. Because the well pump was wired in series with the fluoride metering pump,

the metering pump operated continuously. Someone had cut the electrical wire on each side of the flow switches and bypassed these switches. The result was an overfeed. If the flow switches had not been bypassed, the fluoride metering pump would not have operated with no water flow. Vandalism was suspected in the incident.

#### 6. Shaftsbury, Vermont, 1980

On Saturday, August 30, 1980, a farmer's market was being held in the school yard of the Shaftsbury Elementary School, with school water being used. Twenty-two people became ill with nausea, abdominal cramps, and vomiting. No school children were involved. The illness resulted from drinking beverages made from the school water. Analysis of the water showed a concentration of 1,041 ppm of fluoride. The illness had a duration of 24 hours. None of the ill people saw a physician or went to a hospital.

The school buys its water from the town of Shaftsbury. The batch saturator system, using sodium fluoride (unsaturated), was operated by a pacing meter in the main line from town. There was no flow switch. There is confusion as to the real cause of the overfeed. The pacing meter had a history of a sticking contact meter disk, which could have caused the feeder to operate continuously. The metering pump also could have been switched to the internal mode (manual) to be primed and then left in this position. This would cause the metering pump to operate continuously. The switch for the internal mode was not spring-loaded.

#### Jonesboro, Maine, 1981

On October 6, 1981, at the Jonesboro Elementary School, 31 persons become ill with gastrointestinal symptoms (nausea, vomiting, and cramps). Two people experienced a brief period of rapid heart rate. The illness was found to have been caused by the high fluoride level in the school water. There was 236 ppm of fluoride found in the coffee made that morning. After 24 hours, all illnesses were over. Thirty-seven persons went to the emergency room at the local hospital. None were hospitalized overnight.

The state fluoridation technician had visited the school the previous day because the fluoride concentration of the water system had not been at optimal level for several weeks. The sodium fluoride saturator system was shut down and inspected. The flow switch was not functioning properly and was replaced. When the system was checked out, it was also found that the anti-siphon valve was not functioning properly. The fluoridation system was left off while the technician returned to Augusta to obtain a new anti-siphon valve. It appears that, unbeknownst to the technician, at the time the tanks were refilling, an unknown amount of saturated sodium fluoride solution was siphoned into the tank. When the custodian arrived at the school the next morning, he did not test the fluoride concentration in the water because he had been told that the fluoridation loop had been shut off, and there was



no need to do any testing. Had he tested it, he would have discovered the high fluoride level in the water. The "slug" of high level of fluoride flowed into the main water line and an overfeed occurred.

8. Hamilton County, Indiana, 1982

On the morning of January 20, 1982, a fluoride overfeed was reported to the Indiana State Board of Health from the Fisher Elementary School in Hamilton County. The fluoride had been tested that morning, and there was no problem, but by midmorning, samples of water revealed fluoride levels up to 280 ppm. Several children became briefly ill, but there was no vomiting. There were no reported illnesses the next day, and no one was hospitalized.

Multiple problems caused the overfeed. First, although the well pump was operating, little or no water was pumped. Also, the flow switch that was wired in series to the fluoride metering pump failed, thus a "slug" of fluoride went into the system. The problem was corrected.

9. Harlan County, Kentucky, 1982

On March 19, 1982, it was reported to the Harlan County Health Department that many school children at Hall Elementary School were becoming ill. They were complaining of stomach pains and experiencing vomiting. The orange juice was found to have 177 ppm of fluoride. School was dismissed at noon for the day. No one was reported to be hospitalized and all illness disappeared within 24 hours. There had been repeated problems with the fluoridation unit and the county health personnel had urged that corrective action be taken. The unit had been turned off during most of 1981. In September, the county sanitarian inspected the fluoridation facility in preparation for operation and found the fluoridation equipment wired incorrectly. He told the county maintenance personnel, who were responsible for the operation of the fluoridation equipment, not to operate the feeder. On March 19, someone from county maintenance turned on the fluoride feeder and the overfeed occurred. The water system was drained and State personnel came and corrected the problem.

10. Duplin County, North Carolina, 1982

On the morning of September 21, 1982, the teacher's aide at North Duplin Elementary School was conducting the daily fluoride test and discovered a very high fluoride concentration in the drinking water. She alerted the principal and the state was immediately contacted. The sodium fluoride saturator system was shut down immediately, but six students did complain of severe nausea. No one was hospitalized. After 24 hours, everyone was reported to be all right. The cause of the overfeed was a malfunction of a "bypass" switch. This switch would cause the fluoride metering pump to operate independently, bypassing the

flow switch and the well pump. This switch was removed and the metering pump wired in series with the flow switch and the well pump. The state lab reported that the highest fluoride concentration was 161 ppm.

**11. Elkhart County, Indiana, 1985**

On September 6, 1985, an overfeed at the Oslo Elementary School in Elkhart County was reported to the Indiana State Board of Health. A fluoride level of 400 to 500 ppm was determined. The overfeed was caused by the failure of the check valve located between the well and the pressure tank. Water leaked back into the well and was repeatedly refluoridated. Also, the custodian was not testing or recording of the amount of fluoride used daily.

Several children became ill with nausea and vomiting. Five were sent home but no one was hospitalized. All were all right the next day. The fluoridation equipment remained off, and the school was preparing to connect the school water system to the city water system.

**12. Franklin County, Vermont, 1985**

On October 17, 1985, an overfeed occurred at the Sheldon Elementary School in Franklin County. The school obtains its water from the Sheldon Springs water system, one of two nearby municipal water systems. The Sheldon Springs water is supplied by a hydro pneumatic system (no storage tank on line).

The problem occurred when a negative pressure developed in the Sheldon Springs water system (all three of their city wells were down), and water flowed from the school system through a pacing meter, back into the municipal system. A check valve in the fluoride feed line (just prior to the fluoride injection point) failed and allowed fluoride to siphon back in the school water system. There were no anti-siphon valves installed.

Thirty-six of the 57 students and staff noted something wrong. Twenty-nine reported ill effects, with 22 having nausea or vomiting. All were reported all right 24 hours later (most were all right within 6 hours). No one was hospitalized. The school fluoridation system was shut down for re-evaluation.

## **II-A. OVERFEED INCIDENTS WITHOUT ILLNESS IN COMMUNITY WATER SYSTEMS**

### **1. Stanford University - San Francisco, California, 1976**

Stanford University obtains its water from the San Francisco Water Department before San Francisco fluoridates its water. Stanford then fluoridates its water at each of its three connections to the San Francisco system. One of the three fluoride stations had an overfeed the weekend of November 15-16, 1976.

Stanford University fluoridates with silicofluoride fed by dry feeders and injection pumps. The fluoride is normally controlled by an automatically paced system, but water plant personnel were testing valves on Friday, November 14, and turned the fluoride feeder to manual operation. The fluoride feeder was left in the manual position all weekend. When the flow of water dropped very low, a high fluoride concentration resulted. After the weekend, water use resumed and the high fluoride moved as a "slug" through the water lines into the buildings on campus. The highest level of fluoride found was 931 ppm. The problem was corrected.

Although there were complaints of bitter tasting water on November 17, there was no reported illness.

### **2. Marin County, California, 1977**

On or about October 22, 1977, the fluoride chemical fluorosilicic acid ( $H_2SiF_6$ ) was accidentally siphoned into the clearwell at the San Geron Water Treatment Plant of the Marin Municipal Water District. A malfunctioning anti-siphon device was to blame. The problem was discovered and reported to the state on October 27.

Although the press reported levels of fluoride up to 8 times the optimum, the detailed report on the overfeed showed only 5.4 ppm at the water plant and 4.3 ppm in town.

There was no reported illness.

### **3. St. Charles, Minnesota, 1978**

At St. Charles (population 1,900), on August 17, 1978, a technician working on the water system unplugged the fluoride metering pump, which was wired electrically to operate only when the well pump was on. When he replugged the metering pump, he did so into a "hot electrical circuit," causing the fluoride metering pump to operate continuously. Forty gallons of fluorosilicic acid ( $H_2SiF_6$ ) were fed over the weekend while the well pump was off. This "slug" would normally have gone to the consumers, but was dumped before it could be used. Several technicians were sent out to check the fluoride content of the water in various areas. The highest reading they found was 1.8 ppm. By 3:30 in the afternoon, it was back to 1.2 ppm, the optimal feed level for the area. The local health department, to avoid accusation of a

cover-up, notified the local radio station.  
There was no report of illness nor was there widespread publicity or concern.

4. **Fenton, Michigan, 1979**

On May 10, 1979, an excessive concentration of fluoride was accidentally injected into the Fenton public water system. A feed rate of approximately 10 ppm was maintained from 8:00 a.m. until 4:30 p.m. The overfeed was initiated when the operator changed the fluorosilicic solution drum. During placement of a new drum on the line, the fluoride metering pump was turned up to a higher feed rate for priming purposes. The overfeed continued when the operator forgot to turn the metering pump back to its normal setting.

The public was notified on May 11. Fenton has a population of 8,500. As of May 15, no inquiries from the public had occurred, and no illnesses had been reported.

5. **Nisqually Indian Reservation, Washington, 1980**

During the month of September, an overfeed occurred in the tribal water supply system of Nisqually Indian Reservation when the sodium fluoride saturator malfunctioned. The fluoride metering pump and the well pump were wired to different electrical circuits and thus operated separately. Evidently, the well pump was off when the fluoride feeder was in operation. The fluoride level was above 2.0 ppm, but the exact level was unknown.

There were no reported illnesses.

6. **Potsdam, New York, 1981**

There was a reported overfeed at Potsdam, on August 10, 1981. On August 10, between 9:00 a.m. and 12:00 p.m., all the fluorosilicic acid ( $H_2SiF_6$ ) was siphoned from a full 30 gallon carboy (268 lbs). There was no anti-siphon device on the feeder or in the line. The operator discovered the overfeed at noon, reported it to the city and state, and shut down the fluoride feeder. Most of the excess fluoride was caught in the clearwell, which was emptied. The highest fluoride level in town was 8 ppm. Sixteen ppm fluoride was found in the clearwell. There were no reported illnesses.

7. **Alameda County, California, 1982**

An overfeed was reported in the Alameda County Water District on February 19, 1982. The District obtains its water from San Francisco prior to fluoridation by San Francisco. The highest level of fluoride reported was 100 ppm. Alameda County Water District uses a pacing system to automatically feed fluorosilicic acid ( $H_2SiF_6$ ) into the system. The fluoride metering pump at the

Cherry Street Station was turned to manual operation. Cherry Street is just one of five fluoride feed stations and serves a primarily industrial area. The overfeed affected only the Pablo Manufacturing Company which produces gypsum. Since the fluoride metering pump was left in the manual position over the weekend, a high concentration of fluoride resulted. On Monday, February 19, it moved as a "slug" into the Pablo Manufacturing area. Because of the copper lines in the area, the water turned blue (75 ppm of copper). The District sent letters to its 86 employees offering free medical exams. Four employees were examined and no adverse effects were discovered.

There were no reported illness.

#### 8. Henry County, Illinois, 1988

On August 10, 1988, in the Timberbrook Estates Subdivision in Henry County, Illinois, a high fluoride sample was collected. It was received at the state lab on August 15 and found to have 1,280 mg/L of fluoride. The operator was called immediately by state dental health personnel and told to shut down the fluoride equipment, which she did. The operator had performed no lab tests for the month of August. The subdivision had one drilled well and fed fluorosilicic acid.

During an early August visit, the operator said she and a friend were observing the fluoride feeder and determined that the feeder was not running because there was no electrical current at the wall socket. A drop cord was then utilized from another socket (hot) in the next room and connected to the fluoride feeder pump. The pump immediately came alive and started feeding the fluoride solution continually for a period of approximately one week. The operator noticed that the fluoride solution level in the plastic tank was down more than usual but surmised that their water well service man had drained the pressure tank, resulting in higher fluoride use. On August 10, the high fluoride sample was collected from a sample tap that was within six inches downstream of the injection point.

There were approximately 37 families (population - 120) in the subdivision. The conclusion was that a "slug" of fluoride solution was in the line near the injection point when the sample was collected and the sample was not representative of the water in the system. The operator was given detailed instructions regarding the fluoride feed system. She was told never to plug any chemical feed pump into a hot socket and that the original socket was connected to the same electrical circuit as the well pump.

Regarding the water samples, she was told to discontinue use of the sample tap at the plant and instead to collect fluoride samples from her own house or other houses in the subdivision. She was instructed in the use of the fluoride test kit, and told of the importance of daily testing and the need to keep copies on hand of the monthly operation report forms.

There were no reported complaints (each family was interviewed) and no reported illnesses.

9. Scioto County, Ohio, 1988

On September 5, 1988, the Scioto County Regional Water Authority had a reported overfeed of fluoride in their water system. At the 2.5 MGD line-softening water plant, operators use fluorosilicic acid in carboys to fluoride the drinking water. The highest reported fluoride level in the distribution system was 9.9 mg/L.

At the water plant, a fluoride level of 13.9 was found.

The reason for the overfeed was that an anti-siphon valve malfunctioned. At 2:00 p.m. the operator had noticed an excess amount of acid being used, and cut off the power to the fluoride metering pump. Of course, this had no effect on stopping the siphoning of acid out of the 50 gallon carboy. At 4:00 p.m. the error was noticed and the fluoride metering pumps feed line was removed.

Fluoridation by the Scioto County Regional Water Authority was suspended until corrections were made.

There were no reported illnesses.

10. Arnold, Maryland, 1988

On November 30, 1988, the 5 MGD water plant at Arnold, Maryland, was taken out of service and a malfunctioning valve on the plant discharge line was replaced. That evening the water plant was put back in service. The next day, December 1, the routine fluoride analysis showed that there was a fluoride overfeed. Additional fluoride tests indicated the high fluoride was in the water plant lines and in the distribution system. The highest fluoride level found was 7 mg/L. The water plant serves an estimated 50,000 consumers. The water lines were flushed out and after repairs were made the water system resumed operation, including fluoridation.

The cause of the overfeed was the siphoning of the fluoride chemical, fluorosilicic acid, from the fluoride storage tank into the plant discharge line. This was caused by a deteriorated check valve in the discharge side of the fluoride metering pump. The manufacturer had not supplied corrosion protected valves. Also, the metering pump did not have an anti-siphon valve on the discharge side of the metering pump. Both of these items are required by the state.

There were no reported complaints, illnesses, or hospitalizations.

11. Bayfield, Colorado, 1988

On December 7, 1988, water samples were taken at the Narrow Gauge Mobile Park near Bayfield, Colorado. They were analyzed by the state lab before December 28, 1988, and found to be high in fluoride, 20 mg/L. The trailer park water system uses 4 wells; Well No. 3 is "high" in fluoride and is used to "blend" the proper amount of fluoride into the system. Additional water samples analyzed by the state lab showed that Well No. 3 had fluoride levels up to 21 mg/L.

Well No. 3 is no longer used for supplying water at the trailer park. There were 10 to 12 children residing in the trailer park that were under 12 years of age. A copy of

the state lab report, which showed what possibly was the highest natural fluoride content in wells in the U.S, was requested. Copies of these results could not be obtained, and later some doubt was cast on their validity.

There were no reported illnesses or complaints.

**12. Southington, Connecticut, 1989**

On December 8, 1989, the water department in the town of Southington, Connecticut, notified the Connecticut State Department of Health Services (Bureau of Health Promotion) of a fluoride overfeed to the town's water supply. The overfeed was described as 15,000 to 75,000 gallons of water at a rate of 500 gal/min. for approximately 30 minutes at 32 ppm fluoride. The city has wells and uses an aeration tower to strip out some organics in the drinking water. The aeration tower was shut down for maintenance and a back siphonage occurred. The back flow prevention device in the make-up water line to the sodium fluoride up flow saturator failed.

CDC was contacted regarding the overfeed and advised flushing, then testing the system and an advisory to residents, all of which already had been done.

No illnesses were reported.

**13. Hagerstown, Indiana, 1990**

On March 1, 1990, an overfeed of fluoride occurred in the water supply system at Hagerstown, Indiana. The city has 2 wells (No. 3 & No. 4) in operation. The fluoride level reached 35 ppm in the water line at the well house (No. 4). The actual fluoride level in the water in the distribution system is not known but was thought to be "not very high". Certainly, it was below 35 ppm.

It was assumed that each well was producing 300 gpm, but in reality the total flow, approximately 600 gpm, was coming from Well No. 3. Well No. 4 was in operation but producing almost no water. Each well has its own fluoride metering pump which was feeding fluoride at a well rate of 300 gpm. On March 1 a new gate valve was installed and the workmen forgot to reopen the main gate valve. This allowed Well No. 3 and Well No. 4 fluoride metering pumps to operate for 12 hours with no water flow from the wells. The problem was discovered when the city ran out of water. The overfeed was found and the water main was flushed. Water samples tested in town did not show any high fluoride levels. There were no reported illnesses.

**14. Galax, Virginia, 1990**

On June 18, 1990, the State Lab for the Virginia Department of Health became concerned about the fluoride test results of 22 ppm in a water sample from the Galax water treatment system. The State lab had several other fluoride test results that were quite high - from 19 ppm to 22 ppm. State engineers visited the Galax

water system, took additional water samples, and checked city records for the amount of water produced daily and the amount of fluoride chemical used daily. The fluoride test results showed a natural fluoride level of less than 0.1 ppm and a fluoride level of between 1.0 and 2.0 ppm in the finished water. Also, the calculated fluoride level was approximately 1.0 ppm. The State could not determine the cause of the "overfeed", but after discussion with the State lab personnel believe "the state lab results were accurate".

It appears that there was no overfeed and there certainly were no illnesses.

**15. Florence, South Carolina, 1991**

On May 17, 1991, an overfeed occurred at the water plant in Florence. On May 23, a private laboratory, which does the city's water analyses, reported to the State health department that a sample collected from the city water system had a fluoride level of 64 ppm. The overfeed resulted when the method of backwashing the filters to remove iron was changed allowing a concentrated fluoride solution (sodium silicofluoride) to be pumped into the distribution system after the backwashing of the filters was completed. In 1990, the backwash procedure was changed but the fluoride injection point was not. Thus, under the new procedure, the fluoride metering pump was on when the high service pump was on, but there was no flow in the water line, causing a "slug" of high fluoride to enter the distribution lines. There were no complaints or reported illnesses. The city was fined \$10,000 by the State and ordered to make corrections. The city resumed water fluoridation after the corrections were made.

**16. St. Francis, South Dakota, 1992**

During the week of August 14, a water sample was pulled from the water system in the community of St. Francis and sent to the state lab for routine fluoride analysis. The State of South Dakota then notified the Indian Health Service that the water sample submitted had 44.9 ppm of fluoride in it. The community of St. Francis is an incorporated community of approximately 223 homes, mostly Indian. The pumphouse and well were constructed by the Bureau of Indian Affairs when the new school was built. The water system is operated by the community of St. Francis. Since the controls were inoperable, the well pump and fluoridation pump were manually turned on and off by the maintenance personnel. The well pump was observed to be down and the fluoridation metering pump was turned off. During the week of August 21, the Indian Health Service took water samples and found fluoride levels of 2.4 to 2.8 ppm.

Indian Health Service personnel provided evaluation of the well pump, metering pump, and the pumphouse conditions and operating procedure for St. Francis. No problems were found. There is some question about the accuracy of the state lab results.

There were no reported complaints or illnesses.



**17. Sarnia, Ontario, 1993**

On January 20 and 21, 1993 a series errors at the Sarnia water plant resulted in high fluoride being discharged into the Sarnia water system. The exact reasons for the fluoride failures were not revealed. On January 20th the operator took water samples that showed fluoride readings of 17 mg/L, but recorded the false reading of 2.0 mg/L. On January 21st he tested for fluoride and got 8.5 mg/L but recorded 1.8 mg/L. Subsequent tests collected later on the 21st at three locations in the city showed reading of 4.9 mg/L; 12 mg/L; and 13 mg/L. The optimal fluoride level in Sarnia was 1.2 mg/L.

In 1995 the operator plead guilty to giving false information and entering false fluoride test results into the records. He was fined \$1,200. No one reported ill or no one was hospitalized.

**18. Highland Falls, New York, 1993**

On May 27, 1993 there was an overfeed in the water supply system (fluorosilicic acid feed system) for the Village of Highland Falls. The State discovered the high fluoride level of 9.4 ppm in their monthly surveillance water sample. It is not clear how long the overfeed lasted or how high the fluoride levels in the distribution system were.

The city's fluoride testing equipment was found to be malfunctioning. The fluoride standards were too old. The anti-siphon valve was defective, and had never been cleaned. After the flow switch malfunctioned, the water plant operator hot-wired the fluoride metering pump to a general electrical outlet. Any of the above could have caused the overfeed.

There were no reported illness. The city was fined \$2,000 by the State for the overfeed.

**19. Middletown, Maryland, 1993**

In Middletown, on November 16, 1993, an overfeed occurred for approximately 10 ½ hours, when the pacing meter malfunctioned in the city water supply system. Most water samples taken in the distribution system had a level of fluoride between 4 and 10 ppm, except for one odd sample of 70 ppm. The city has both wells and springs that go into a reservoir then into the water system.

The city flushed out the affected water lines, replaced the pacing meter [the original pacing meter was over-designed] and restarted the acid feeder system. There were no reported illness.

**20. Longmont County, Colorado - 1994**

On Sunday morning, October 9, 1994, a fluoride dry feeder using sodium

silicofluoride was shut down for maintenance. The fluoride slurry in the solution tank was mistakenly fed into the system and got into the 27 inch main water line, resulting in an overfeed. The water plant operator quickly identified the problem and took action. The highest reported fluoride level in the water line in the distribution system was 24 ppm. The water plant was shut down and the state fluoridation engineer was called. After the water line was flushed and the fluoride level in the water line dropped below 2 ppm, the water treatment plant, including water fluoridation, was restarted.

There were no complaints or reported illnesses.

#### 21. Coalton, West Virginia - 1994

Between August 23 and August 29, 1994, the saturated solution from a sodium fluoride saturator was siphoned into a well at the Coalton water plant. There was no anti-siphon valve on the discharge side of the metering pump, no water meter to monitor gallons of water fed into the saturator, and the metering pump was oversized. Because the operator was doing daily testing, he caught the problem immediately, stopped fluoridating, and started diluting the water in the clearwell and storage tank. The highest fluoride level reported from a water sample in the main water line was 21.8 ppm.

After a new and smaller metering pump with a anti-syphon valve was installed and a water meter installed, the fluoridation system was restarted. There were no reported illness or complaints.

#### 22. Stockton, Missouri - 1995

On August 29, 1995 a fluoride overfeed occurred in water supply system in Stockton, Missouri . The Stockton water system has two wells and feed fluorosilicic acid at each well. On Wednesday morning [August 30th] the water plant operator discovered at one of the wells, Well No. 1, that 53.8 pounds of acid had been injected over the past 24 hours. This would have resulted in a calculated fluoride concentration of 34 mg/L at one well or 17 mg/L in the entire system. Normally, the pump only used 3 or 4 pounds per day. Residents were immediately warned not to drink city water. Unfortunately, the city does not have a reading that shows exactly how high the fluoride level was when the overfeed was detected. Later in the afternoon, three tests at various locations showed fluoride levels of 6.0, 3.5 and 2.5 mg/L in the drinking water.

The city had recently [8 months ago] changed from feeding sodium fluoride to fluorosilicic acid. They used the same metering pumps for the new acid feed system. When the 150 pound acid drum was changed at Well No 1 on August 19, the new drum was not hooked up properly to the system. The old acid drum ran dry causing the regulator valve to stick. The problem was discovered and corrected on the morning of August 29, but the operator, following the manufacturer's instructions, turned the pump to its highest setting to be primed. Because the pump

was over designed, because it was previously used for feeding sodium fluoride, this caused a very high flow of acid to start going into the system. The operator immediately [within 15 minutes] tested for the fluoride concentration and found only 0.8 mg/L, nearly the correct amount. But the fluoride testing site was directly across from the fluoride injection point not 100 feet downstream as recommended. Thus, the operator did not correctly measure the fluoride level in the drinking water. Finally, as the operator did not have proper instructions as to the proper pump settings he left the setting on high until the next day, resulting in the overfeed. There were no reported illness or complaints. The water system was properly flushed, the problems found and corrected, and water fluoridation was restarted on September 5th.

**23. Bois Forte Reservation, Minnesota, 1997**

On October 2, 1997 a suspected fluoride overfeed at the a northern Minnesota Indian reservation, the Bois Forte Reservation, was reported to the district office of the Indian Health Service. On the morning of October 1st, the water plant operator had mixed 5 gallons of 23% fluorosilicic acid with 25 gallons of water. This was added to the 10 gallons of premixed fluoride solution previously remaining in the vat. The speed and stroke settings on the metering pump were turned to 100% for priming the pump. The operator forgot to check on the pump until the next day, the afternoon of the 2nd. Over 10 gallons of the fluoride solution was missing from the vat. When the operator reported the overfeed, she was advised to disconnect the fluoride pump, notify all household not to drink the water, drain the storage tank and flush the distribution lines, all of which she did. A fluoride sample taken the next morning showed a fluoride concentration of 4.5 mg/L. After the fluoride level dropped to below 1.0 mg/L, the customers were notified that the water was safe to drink. Fluoridation was restarted soon after. There were no reported illness or complaints.

**24. Duncan Falls, Ohio, 1998**

On January 13, 1998 an overfeed occurred in the East Muskingum Water System at the water treatment plant on Wayne Ridge Road. Conjecture was that approximately 100 pounds of fluorosilicic acid had back-siphoned into a storage tank after the high service pump had stopped operating, thus resulting in the overfeed. Later, speculation was that the fluoride metering pump has stuck open to cause the overfeed. The plant does not pump water 24 hours per day. The water from the storage tank flows to a pumping station where there are two distribution lines, one to Duncan Falls and the Pine Knolls Subdivision and one to the rest of the system. The higher fluoride reading were in Duncan Falls. The highest reported fluoride reading was 23.6 mg/L. A radio advisory was given but the several radio and TV stations initially interpreted

the "No Drink" as a "Boil Order" advisory. [Boiling concentrates the fluoride.] Corrections to the advisory were soon made. The state required the water system to - - give public notification under a violation of the Safe Drinking Water Act - exceeding the fluoride maximum contaminant level of 4.0 mg/L. [Which, of course, is not a correct interpretation of the Safe Drinking Water Act.] There were no reported illness or complaints and fluoridation was resumed after it was determined that the metering pumps were operating properly.

**II-B. OVERFEED INCIDENTS WITHOUT ILLNESS IN SCHOOL WATER FLUORIDATION SYSTEMS**

**1. Hamilton County, Indiana, 1989**

At the Hamilton Southeastern Middle School in Hamilton County, Indiana, on the morning of May 9, 1989, there was a reported fluoride overfeed. The school fluoridates the drinking water from its two wells with sodium fluoride. The operator tested the water for fluoride prior to the start of the school day and found that the fluoride level was over 10 ppm. (He could only test up to 10 ppm and did not save the sample water.) Following the state's shut-off procedures, the fluoride feed system was shut down. It was found that on one of the wells the fluoride metering pump kept operating when the well was not pumping water. The in-line flow switch (sensor) totally failed. All water lines were flushed, and the children were never in any danger of illness, because the operator had followed the state's surveillance and shut down procedures. There was no illness.

### **III. FLUORIDE NON-OVERFEED INCIDENTS**

#### **1. Marysville, Michigan, 1983**

On November 22 and 29, 1983, the Marysville water treatment plant experienced problems with higher levels of fluoride. The problems were caused by a change in the grade of sodium silicofluoride used at the plant.

Normally, the city uses a roller or regular grade compound. Since the city did not specify the grade of sodium silicofluoride in its order, the No. 200 ground, or granular, grade was shipped. When the city added the granular grade compound to its chemical feeder, the chemical was unable to establish a bridging effect on the feeder's horizontal rotating distribution plate. This allowed the granular grade compound to flow directly from the storage hopper, over the plate, and into the solution tank. This "flow through" problem occurred twice.

In the first incident, calculations indicated a fluoride dosage of 8.82 mg/L. The problem was found soon enough to prevent the "slug" of fluoridated water from reaching the finished water by draining the settling basins and backwashing the filters. Analyses showed fluoride levels of greater than 2.0 ppm within the plant, but normal levels in the finished water.

The second overfeed problem occurred on November 29 because the fluoride chemical "flowed" through the machine again after it was shut off. This time highly fluoridated water did reach the plant clearwells. When the problem was found, the clearwells were pumped to waste. Again, distribution samples showed normal fluoride levels.

The problem was corrected by ordering the correct grade of sodium silicofluoride. There was no illness because the fluoride level in the distribution system never exceeded 1.0 ppm.

#### **2. Lake County, Ohio, 1986**

On June 3, 1986, there was an overfeed of fluoride in the drinking water at Lake County Utility District, Lake County, Ohio. The Utility District serves approximately 10,000 people but the overfeed potentially affected only a very small area. A fluoride metering pump malfunctioned and 4.5 gallons of fluorosilicic acid were discharged to the clear well at the utility's water plant. The fluoride concentration reached 9.0 ppm. The problem was corrected and the clear well flushed out. It was believed that the high fluoride water did not enter the main water distribution lines.

There were no reported illnesses or complaints.

#### **3. Martinsville, Virginia, 1987**

On July 1, 1987, the City of Martinsville, Virginia, had a high level of fluoride in the

raw water at the City's water treatment plant. The high level of fluoride occurred due to the malfunction of a float control in the day-tank feed facilities. The high level of fluoride was discovered by city personnel when problems were encountered with treatment of the water. Once the city personnel had identified the problem, the fluoride feed facilities were cut off and two of the sedimentation basins removed from service and drained. The highest fluoride level detected in the distribution system was 1.6 mg/L. The fluoride feed facilities were cut off on July 1, and were not restored to service until July 6, 1987. During this time, fluoride testing was performed at six locations within the distribution system. There were no reported illnesses.

#### 4. Emporia, Virginia, 1987

On November 25, Tom Reeves of the Centers for Disease Control, was called by the manager of a dialysis center in Emporia, Virginia. She informed him that she had just been notified by a city official at the water plant that there had been an overfeed of fluoride chemical (14 ppm) into the local water system. She wished to know if she could use that water for dialysis procedures. As the dialysis center was only using activated charcoal for the removal of impurities from the city drinking water supply, she was urged not to use the water. There had been no dialysis performed with any water containing the excessive fluoride.

The following is a synopsis of events regarding this situation:

- a. On November 25, a city water plant operator noticed that an extra quantity of fluoride chemical had been used. He tested the water and found 2.1 ppm of fluoride. (The recommended optimal fluoride level is 0.9 ppm for all community water systems in Virginia.) He reported this finding to the utility manager, the manager decided to verify the results, and had a sample taken to the city laboratory in nearby Roanoke, North Carolina, this laboratory reported 14 ppm of fluoride.
- b. The utility manager then called the manager of the dialysis center, and told her not to use the water for dialysis until the fluoride issue could be clarified. Next, he called the state District Engineer, who immediately came to Emporia and tested the water. He also found a reading of 2.1 ppm.
- c. A sample of water was sent to Consolidated Laboratories in Richmond, Virginia, (a U.S. Environmental Protection Agency certified lab), which reported 2.05 ppm of fluoride in the sample tested.

Thus, there really was no fluoride overfeed in Emporia. The city dumped the water from their clearwell as waste, and resumed normal operation.

There were no reported illnesses.

#### 5. Cambridge, Ohio, 1992

On July 13, 1992, the Cambridge, Ohio, water supply system experienced an overdose of fluorosilicic acid into the drinking water at the water plant. A broken

fluoride metering pump allowed approximately 200 pounds of acid to enter the drinking water in about one hour. Normally, the city waterworks uses 10-14 pounds of acid daily. Although the high fluoride "slug" of water probably did not get out into the main water distribution system, the consumers were notified through radio announcements not to drink the water. The main lines were flushed and underground storage tanks (clearwells) were drained. The city treats approximately 4 MGD of water. There were no reported illnesses.

6. Marin County, California, 1992

On July 5, 1992, in Marin County, California, the Marin Municipal Water District (MMWD) experienced a failure in a storage tank pump that stored fluorosilicic acid. The failure resulted in a leak of fluoride chemical into their wash water recovery (WWR) system via the floor drain in the storage room. The WWR system recycles water back through the treatment plant. Fluoride levels in the WWR system were in the 200 ppm range. Since MMWD has neither the authority nor the physical ability to simply dump this water, it was recycled back into their raw water reservoir. They diluted it back through the treatment plant at levels below 2 ppm. However, the water that was in the treatment plant itself was at a level of about 18 ppm. In order to get rid of this water, the district diluted this effluent through the clear well. For a period of 4-6 hours, water containing fluoride at levels below 5 ppm was going out into the distribution system. State and city officials believed there was no threat to consumers; therefore, no emergency notification of consumers was required. To all concerned, this situation was considered to be a minor emergency. The very high fluoride did not get out into the distribution system and there were no reported illnesses.

7. Snowmass Village, Colorado, 1997

There was an overfeed incident on October 17, 1997 at the water treatment plant at the Snowmass Water and Sanitation District in Snowmass Village, Colorado. The highest reported fluoride level was 4.4 mg/L in the clearwell. The water in the distribution system never got up to 4.0 mg/L. The volumetric dry feed malfunctioned due to the timer running at 100% despite being set for a lower setting. Prompt action by the operators prevented any of the high fluoride water from getting into the distribution system. The clearwell was drained and the timer replaced on the dry feeder, then water fluoridation was restarted. There were no reported illness or complaints.



#### IV. FLUORIDE-RELATED INDUSTRIAL ACCIDENTS

##### 1. Lebanon, Pennsylvania, 1975

\* On August 20, 1975, at the City of Lebanon water plant, the 6,000 gallon bulk storage tank for fluorosilicic acid developed a 20-inch crack. The tank was located in a room in the plant. The floor drain in that room discharged to the waste stabilization lagoon, which consists of 2 ponds operated in series with the effluent discharging to Swatara Creek. Approximately 1,500 gallons of fluorosilicic acid escaped to the lagoon. The state traced the discharge of acid by measuring the pH of the waste waters. The pH in the first pond was 3.8, the second pond was 7.1. Raw water was added to the first pond to dilute the acid. The discharge of acid to the creek was minimal. Some localized fish (tadpoles and sunfish) were killed in the first pond.

##### 2. Seattle, Washington, 1976

On May 17, 1976, the Seattle Water Department had an accident at its treatment plant at Landsburg on the Cedar River and spilled 5,000 gallons of fluorosilicic acid. The accident occurred while workmen were transferring the acid from one of the fiberglass tanks, which had been leaking, to a new rubber-lined steel tank to replace it. One of the connectors broke and allowed the large quantity to escape. The city spread 2 tons of calcium hydroxide (a lime slurry) over the spill area. The spill was approximately 300 feet from the river and flowed toward the railroad tracks away from the river. The river was monitored at two locations every day for a year. No one was injured, nor was there any environmental damage. The Seattle Water System was not affected, of course. One interesting note, Dr. John Yiamouyiannis, from the National Health Federation, visited the spill site on May 23, and declared that enough acid was spilled to kill every man, woman, and child in Seattle.

##### 3. Syracuse, New York, 1977

\* On the morning of March 19, 1977, there was an inadvertent discharge of fluorosilicic acid into Skaneateles Creek, from the City of Syracuse water plant. The contents of the 5,000 gallon underground storage tank were emptied (exact amount unknown) over a period of two hours. It was estimated the tank was half full. The exact reason for the discharge is not known. The stream flow that morning was estimated to be 30 MGD. The city added additional water to the creek in order to dilute the effects of the acid. There was a fish kill in the creek but no human illnesses or injuries occurred. The drinking water in the Syracuse water system was not affected.

4. El Rito, New Mexico, 1978



On June 5, 1978, New Mexico state officials were contacted about the death of 2 horses in the area of the El Rito Water Association wellhouse. It was claimed that something around the wellhouse had caused their deaths. The Association fluoridates their water system using the sodium fluoride batch mix method. On May 17, 1978, the water plant operator cleaned the sodium fluoride solution tank and deposited a chalk-like residue outside the wellhouse. A nearby rancher charged that this residue, which was found to be 80% sodium fluoride, was the cause of death of his 2 horses. The issue was never resolved, because the horses were considered to be trespassing. (Note, while it was not proved, there was strong evidence that the horses used the residue of fluoride as a "salt lick"). There was never any danger to the water system or to the environment around the wellhouse.

5. Pendleton, Oregon, 1981

Between June 2 and June 8, 1981, at Pendleton, Oregon, a pipe from the bulk storage tank to the city water well broke, causing 4,000 gallons of fluorosilicic acid to leak into the ground. The break was caused by a bind in the pipe. Concentration of fluorides of 17 and 23 ppm were found in the surface water that flows through the area. The city used city water to further dilute the concentration of acid. Testing for fluorides in the well did not reveal any contamination of the water supply. The city tested 3 times per day for 2 days and then daily thereafter for some time. There was no evidence that the well was ever contaminated. No injuries or illnesses were reported.

6. Benton County, Arkansas, 1982

On July 26, 1983, approximately 2,500 gallons of fluorosilicic acid leaked out of the Beaver Water District Treatment Plant onto the ground in Benton County, Arkansas. The soil contains large beds of crushed limestone. The area was neutralized with lime ( $\text{CaOH}_2$ ). The area's ground water and surface water were sampled and analyzed for fluoride. There was no sign of contamination except in the immediate area. Fluoride levels in the immediate area were up to 6.3 ppm. Sampling continued for over one year.

The spill occurred when a gasket on the outlet line from the bulk storage tank began leaking. There was no illness reported, nor any long-term environmental damage. Of course, there was no danger to the drinking water system.

7. Charleston, South Carolina, 1984

On January 30, 1984, approximately 3,000 gallons of fluorosilicic acid leaked out of a bulk storage tank at the Hanahan Water Treatment Plant, which is part of the

Charleston Water System in Charleston, South Carolina. The tank ruptured in the early morning, spilling the acid into a storm drainage ditch that discharged to Goose Creek Reservoir. The spill was contained and neutralized with lime. There was no evidence that the acid reached Goose Creek Reservoir. There were no illnesses or injuries reported. There was no effect on the water system except they were out of fluoride chemical.

8. Pendleton, Oregon, 1984

On the afternoon of November 21, 1984, at Pendleton, Oregon, an accident resulted in 3,500 gallons of fluorosilicic acid spilling into a roadside ditch. The accident occurred when an employee of the city was performing routine maintenance on the fluoridation system. He fell as he was climbing down into a vault containing the bulk storage tank and broke a plastic valve. All the acid in the tank leaked into a roadside ditch. The operator received superficial burns. The city neutralized the acid with lime and then added water from a city water main to dilute the remaining acid.

The city worker (operator) was briefly treated for slight burns and released at a nearby hospital. The city tested public and private wells in the area for a "considerable length of time" without any reported adverse effects.

9. Greenville, South Carolina, 1984

On December 18, 1984, a leak was discovered in the fluorosilicic acid bulk storage tanks in the Greenville water system at Greenville, South Carolina. Approximately 300 gallons leaked out of the 5,000 gallon storage tank. There was no reported ground water contamination or any long-term environmental damage. The only effect on the drinking water system was that they were without fluoridation for approximately 4 months.

There was no reported illness.

10. Charleston, Illinois, 1985

On August 15, 1985, two water plant operators were injured (one very seriously) in an explosion as a result of an accidental mixing of two chemical solutions. The two chemicals were sodium chlorite ( $\text{NaClO}_2$ ) and fluorosilicic acid ( $\text{H}_2\text{SiF}_6$ ).

Handling the fluorosilicic acid at the Charleston plant amounts to exchanging an almost empty barrel with a full barrel. Sodium chlorite is produced by combining chlorine gas with liquid sodium. This batch solution is then placed in a barrel at the chlorine feeder. The chlorine feed system is programmed to yield the desired chlorine dioxide in the water, and the fluoride metering pump provides the correct amount of fluoride.

The barrels of chlorine and fluoride are exactly the same in appearance, except for an inconspicuous black and white label identifying the chemical. Also, both

metering pumps were adjacent to each other.

On August 15, an operator mistakenly poured a batch of sodium chlorite into the fluorosilicic acid barrel. Sodium chloride has a very high pH, and fluorosilicic acid has a very low pH. A chemical reaction started immediately and grew in intensity, releasing heavy fumes into the room. The operators then decided it best to move the affected barrel outdoors. They put a lid on the barrel and got halfway across the room when the explosion occurred. The explosion blew out most of the windows, but there was no other apparent damage to the room or the building. One operator suffered a broken arm. The other operator was in serious condition with multiple injuries to his lungs, head and face, and both hands. It was reported that both operators were using the Scott air pack breathing device at the time.

Charleston was told by the state personnel that the Illinois fluoridation law required Charleston to continue fluoridating. The city will begin again after re-evaluating the fluoride chemical and equipment to be used.

#### **11. Las Vegas, New Mexico, 1986**

On March 20, 1986, a fluorosilicic acid spill was reported from Las Vegas, New Mexico. The city had just filled their bulk storage tank (located inside a metal building) with 3,500 gallons of fluorosilicic acid. A small leak developed in a horizontal crack around the base of the tank. The acid was leaking out at a rate of 30 gallons per 24 hours. City personnel overreacted, closed a nearby road and asked for the state Police, fearing an explosion. The city was reassured by CDC that the acid could not explode and there was no reason to close the nearby road. Corrective measures were explained to them, which primarily consisted of obtaining lime and spreading it on the spill and contacting the fluoride chemical distributor to remove the remaining acid.

On Friday, March 21, the situation was resolved by having the acid removed to two smaller rubber-lined tanks. There was never any danger to their water system.

#### **12. Schenectady, New York, 1988**

On Monday, January 11, 1988 at the Schenectady Water Plant, fluorosilicic acid had leaked from two 2000 gallon rubber lined steel bulk storage tanks into the surrounding concrete enclosure. The City of Schenectady's water system has a capacity of 38 mgd but produces an average of 16 mgd for a population over 77,500. The source is a ground water supply consisting of eleven wells; treatment consists of chlorination and fluoridation. The leak occurred sometime between 8 am Sunday, January 10, and 8 am Monday, January 11th.

A contractor was contacted and engaged by the city to neutralize, clean up, and dispose of all materials related to the spill. They started the afternoon of the 11th. The cause of the leak was found to be a flange connection in the piping system underneath one of the tanks. Approximately 2100 gallons of acid were spilled. The appropriate authorities were notified and the drinking water system was never

compromised. There were no reported illnesses or complaints.

13. New York City, New York, 1988

The New York City Water System has been adding fluorosilicic acid at three locations since 1965. On July 26, 1988, at the Delaware River Treatment Plant and on August 11, 1988, at the Catskill Treatment Plant, the shaft of a petrometer tube was broken, spilling mercury on the floor in each case. The fluoride feed system had to be shut down at each plant until the mercury was cleaned up, which was completed by the middle of September. Although foul play was initially suspected, no reason was ever found for the accidents. No one was hurt and water fluoridation was not affected except for being off for several weeks.

14. Winnipeg, Manitoba, 1989

On January 31, 1989, an accidental spill of fluorosilicic acid occurred at the water plant at Winnipeg, Manitoba. The spill was caused by over filling the day tanks and expulsion of some 26,000 liters (approximately 7,000 gallons) of acid up and out of the vent stack onto the roof berm of the intake structure. The spill was neutralized with lime and cleaned up. The clean-up was complicated by the snow and bad weather conditions. There was no contamination of the city water supply and no illness. All appropriate officials were notified.

15. Burlington, North Carolina, 1991

On September 5, 1991, a spill of 4,000 gallons of fluorosilicic acid spilled from a bulk storage tank outside the water plant at Burlington, North Carolina. The acid went into the containment area and onto the ground around the tank. The fluoride solution in the containment area was pumped into a holding tank and neutralized. Sand, caustic soda, and lime were spread over the ground. The 6,000 gallon fiberglass bulk storage tank was 13 years old and it had developed cracks prior to breaking open. There was no danger to the public and the spill did not directly affect the drinking water supply except for the loss of water fluoridation. It was estimated that within 3 months the city would be back fluoridating their drinking water.

16. Cartersville, Georgia, 1992

In December 1992, CDC received a call from the superintendent of the water utility in Cartersville (population 16,000), Georgia. He was concerned about the effects of high fluoride in their drinking water. In late November, coffee was made at the water plant and three people either drank some of the water or the coffee and complained of the bitter taste. All felt weak, nauseous, and sick. One lady was very concerned about the effects of high fluoride because she may be several weeks

pregnant.

The superintendent explained that there was a back siphonage from the solution tank of the volumetric dry feeder that fed sodium silicofluoride. This back siphonage had only effected the water plant personnel that used drinking water from the employees' lounge in the water plant.

The feed system for the sodium silicofluoride had been designed and installed over 20 years ago. The fluoride feed room is located above the employees lounge and numerous changes have been made since then. Approximately two years before major changes were made to the fluoridated feed system evidently with no major problems. It is believed that a second submerged line was added from the make-up water line to the solution tank. The prior design had an air gap between the water line and the solution tank. Three months before, additional changes were made that resulted in frequent low pressures in the make-up water line to the solution tank. Also, about this time the state recommended that water samples be taken to test for lead and copper to determine if the drinking water would meet the new EPA "lead and copper rule". The state recommended that the water faucet be allowed to run for at least 10 minutes prior to taking the water sample for testing. It is thought that the combination of the low pressure in the make-up water line and the long running time of the water for the lead and copper test sample resulted in the back siphonage of the high fluoride from the solution tank of the volumetric feeder.

No water sample with the high fluoride was kept, so the exact level of fluoride is unknown. But, the utility uses an ion electrode to test for fluoride and the ion electrode meter "pegged". The state engineer visited the site to ensure that corrections had been made (they had) and to offer anyone there a free blood and/or urine test for fluoride. No one wished to have a test taken. The city is continuing to fluoridate.

There were a total of 7 people at risk although only 3 people were known to be affected. No one was hospitalized.

#### 17. Springfield, Illinois, 1993

On May 4, 1993, 3,000 gallons of fluorosilicic acid and 1,000 gallons of sodium hydroxide were accidentally mixed in a steel storage tank at the Springfield Water Treatment Plant. The potentially explosive nature of the situation resulted in heat and steam being produced, which caused minor injuries to both city employees and local firefighters. They were treated at the local hospitals. Water fluoridation was not directly affected.

#### 18. Burlington, Massachusetts, 1994

On May 2, 1994, approximately 10 gallons of fluorosilicic acid accidentally overflowed a 36 gallon day tank at the Burlington Water Treatment Plant. Three local fire departments were called and residents from five adjacent homes were asked to evacuate before the spill was neutralized with baking soda and lime. This

clearly was a case of overreactions. No one was injured or became ill.

19. **Bridgeport, Texas, 1994**

On Friday, July 1, 1994, 500 gallons of fluorosilicic acid were spilled from a storage tank at the water treatment plant in the City of Bridgeport. The water plant operator accidentally dropped a piece of machinery on the outlet flange of the 3,000 gallon bulk storage tank, breaking the flange. There were no injuries as a result of the spill and no chemical spread beyond the city owned property. Although there was no press coverage of the incident, several water plant operators insisted that fluoridation is a hazard and asked that the fluoride system be permanently shut down. However, water fluoridation has been restarted.

## V. OTHER FLUORIDE-RELATED INCIDENTS

### 1. McKinney, Texas, 1962

\* A 64 year old farmer from Texas died on May 11, 1962 in McKinney, Texas. An autopsy confirmed the diagnosis of chronic fluoride intoxication. Veterans Administration doctors who reported the strange case indicated the patient apparently drank too much water containing too much fluoride for too long a time. The doctors said the victim suffered, for at least 20 years from a condition called polydipsia - an unquenchable thirst that drove him to drink one to two-and-a-half gallons of water daily. Most of his life, he drank well water containing natural fluoride in amounts 2.8 to 3.5 mg/L. He was born and lived in Calhoun, Georgia where he drank unfluoridated water for the first 7 years of his life. He then moved to Texas where for 43 years, he drank well water with high fluoride content. His diet was unremarkable and was the same as that of his sister and a brother with whom he worked as a farmer. He was very healthy until 1950, when he was first admitted to the hospital for tests. He had stiffness of his knees and ankle joints, spastic weakness of all his extremities and neurological signs. Ligaments and membranes connecting bones were calcified. The literature reports no other cases of chronic fluoride intoxication with radiculomyelopathy in this county, but there are some reports of such cases in India, except at much higher natural fluoride levels. The case is only of interest because those people opposed to water fluoridation cite this case as an example of some one dying from drinking fluoridated water. The claim is often made that the more fluoridated water an individual drinks, the thirstier he/she becomes and thus - can die from drinking the fluoridated water.

### 2. Brooklyn, New York, 1974

\* On May 24, 1974, a three-year-old boy died as a result of swallowing approximately 1.5 ounces of a 4% stannous fluoride solution in a dental office. (This equates to ingesting approximately 435 mg. of fluoride, certainly a lethal dose for a child of his size.) The child and his mother had gone to the City Dental Clinic for his first dental exam. The dentist found no cavities and turned the boy over to a dental hygienist for routine teeth cleaning. After the cleaning, the dental hygienist, using a swab, applied a stannous fluoride gel on the boy's teeth. The boy was given a cup of water to rinse out the gel. The dental hygienist was distracted and the boy drank the water and the gel.

When the boy began vomiting, sweating, and complaining of a headache and dizziness, the dentist explained that the boy was only given a routine treatment. The mother was not satisfied and was sent to Ambulatory Pediatric Care Unit in the same building. She waited 2½ hours before she could get help. The boy became sicker and went into a coma (his mother thought he was sleeping).



Finally, after an examination, the boy was injected with adrenalin and rushed to a nearby hospital (5 minutes). There he waited more than an hour before seeing a doctor. As doctors, attempted to pump his stomach, he went into cardiac arrest and died.

3. New Haven, Connecticut, 1974

A 2 ½ year old girl was brought to the emergency room of a hospital because of progressive vomiting and lethargy. Prior to becoming ill, the child had been playing with a commercial laundry powder. This powder contained a whitener with sodium silicofluoride as its major ingredient. Calcium gluconate was given intravenously and serum calcium was given by dialysis. The patient became responsive 18 hours after admission and returned to full consciousness two days later.

4. Baltimore, Maryland, 1979

A 25-year-old man was seen in the emergency room approximately 2 ½ hours following intentional ingestion of a rat poison, a finely textured blue powder in an unmarked cylindrical cardboard container initially thought to contain arsenic but, later found to contain sodium fluoride. Approximately one hour after admission, he developed ventricular fibrillation. After unsuccessful resuscitation, he was pronounced dead.

5. Denver, Colorado, 1979

While completing the fabrication of a gold inlay, a dental student put a casting into an unmarked beaker of hydrofluoric acid was available for use in the laboratory. He mistook it for a beaker of water. After the beaker was taken out of the ultrasonic cleaner, the student tried to remove the small casting with the fingers of his right hand. After 20 to 30 seconds, he recovered the casting and rinsed it and his fingers with tap water. He was still unaware that the solution contained concentrated hydrofluoric acid, as there was no noticeable odor or apparent burn immediately after contact. Half an hour later, the student felt a burning sensation in his fingers of his right hand. The burning sensation seemed internal and the skin appeared normal. After realizing the beaker contained hydrofluoric acid, he immediately soaked his hand in a solution of water and baking soda. The pain became more and more severe. An hour after contact with the acid, the student sought emergency medical care. The next day, additional medical aid was sought, including injection of a solution of 10% calcium gluconate [20 to 30 injections per finger]. After 4 months only slight paresthesia of the fingertips remained and some architectural damage to the fingernails was apparent.

6. Vienna, Austria, 1982

\* In 1982, a three-year-old boy swallowed 200 1 mg. fluoride tablets (16 mg/kg body wt.). This one-time overdose is the equivalent of 32 mg. of sodium fluoride per kilogram of body weight. Immediately following the ingestion, he vomited and then seemed to recover completely, but collapsed 4 hours later. When the family physician arrived, the boy was clinically dead. The child had died seven hours after taking the pills.

7. Raleigh, North Carolina, 1983

On January 5, 1983, a Raleigh man complained to the Food and Drug Administration (FDA) that the Equal sweetener from a Food Lion store in Raleigh did not look right when he emptied a packet of it into his iced tea. He said the sweetener did not dissolve and made the tea look darker. Because of delays, the FDA did not analyze the contents until a month later. They found that the sweetener contained 80 to 85% pure sodium fluoride. One package contained 4 grams of the chemical. [Five grams can be lethal.] The boxes apparently had been bought, the packets slit open with a razor blade and resealed and the boxes put back on the shelves. No stores except Food Lion were involved. Food Lion took all boxes of the sweetener off the shelf. Apparently no one ingested the substance and no illness connected with the tampering were reported. Officials blamed the tampering on someone trying to copy the Tylenol poisonings last year [1982] that resulted in seven deaths.

8. San Diego, California, 1985

\* In 1985, a 29 year old male maintenance worker accidentally drank a mouthful of an unknown "rust remover" that he thought was water. The rust remover was hydrofluoric acid. Immediately after swallowing the chemical the patient became very ill and started vomiting. The patient became very pale and weak. After he was transported to the hospital, his pulse became rapid and weak and respiration was shallow. He died 90 minutes after drinking the acid. A plasma fluoride determination showed an extremely high fluoride level (35.2 mg/L). Normal blood plasma fluoride levels for humans are 0.01 mg/L to 0.02 mg/L. Some studies have suggested that a blood plasma of 3 mg/L of fluoride is lethal.

9. Fairfax, California, 1985

Sometime just before August 23, 1985, a tanker truck on the way to a water treatment plant above Fairfax leaked approximately 50 gallons of fluorosilicic acid due to an improperly closed valve on the truck. The road was closed and the contaminated soil was dug up and removed. There never was any danger to the city water system.

10. Gore, Oklahoma, 1986

On January 4, 1986, there was an accident at the Kerr-McGee Corporation's Sequoyah nuclear facility at Gore, Oklahoma. The plant processes raw uranium into uranium hexafluoride (UF<sub>2</sub>) for use as a nuclear reactor fuel. A 14-ton cylinder tank was overfilled with uranium hexafluoride gas and was heated in an attempt to force the overload back out. The tank ruptured and vented the gas into the atmosphere. The UF<sub>2</sub> reacted with the moisture in the air and created a large cloud of hydrofluoric acid gas. The gas cloud killed one worker and injured 103 other people (generally lung damage).

The Kerr-McGee accident was essentially a chemical spill with no relationship to any drinking water system.

11. Fort Totten, North Dakota, 1986

On April 24, 1986, a second grade teacher mistakenly mixed too high fluoride solution for a school mouthrinse program at an elementary school at Fort Totten. The teacher put a packet of 2 grams of fluoride powder into each of the 14 small dixie cups and then filled each cup with water. The correct dilution is 2 grams of fluoride powder to 1.5 liters of water. Sixteen students were treated at the local hospital and 4 students spent the night for observation.

12. Galax, Virginia, 1986

On September 25, 1986, an elderly couple had their home fumigated by a local pest control company for the control of wood boring insects. Two hundred and fifty pounds of sulfuryl fluoride (SF<sub>2</sub>) a colorless, odorless gas were used. Re-entry was prohibited until the evening of the 26th. After re-entry, wife experienced weakness, nausea, and vomiting and the husband complained of dyspnea and restlessness.

On September 28, the husband had a seizure, followed by cardiopulmonary arrest and died. Inhalation of a toxic agent was not suspected. On October 1, his widow, complaining of severe weakness, dyspnea, and chills, was admitted to the hospital. On October 2, ventricular fibrillation occurred and she died.

It is suggested that these deaths were the result of SF<sub>2</sub> exposure. The woman's blood plasma contained 0.5 mg/L of fluoride. The man's blood plasma was unavailable for testing. Background plasma fluoride levels for humans have been reported to be approximately 0.01 mg/L to 0.2 mg/L. While peak concentrations of 0.06 to 0.4 mg/L have been noted 30 minutes after ingestion of 10 mg of fluoride, these levels have been noted to decrease to 0.2 mg/L within 2-9 hours. Thus, the concentration of 0.5 mg/L found in serum obtained from the woman 6 days after fumigation suggests that she had experienced acute exposure to an elevated concentration of fluoride.

The Occupational Safety and Health Administrations's current permissible exposure limit and the American Conference of Governmental Industrial Hygienists' threshold limit value for SF<sub>2</sub> in an enclosed space are 5 ppm. The level considered immediately dangerous to life and health is 1,000 ppm. It is not known what the air

concentration of SF inside the home was after re-entry, because it was not measured.

13. Old Ocean, Texas, 1988

Hydrogen fluoride (HF) escaped from the refinery at the Phillips Petroleum Company on October 30, 1988, at Old Ocean, Texas. HF is an unstable gas that is produced as a refinery byproduct. (Hydrofluoric acid is a liquid form of hydrogen fluoride.) The fluoride compound is toxic to grazing animals and turns plants brown. Although there were no initial reports of injury, two women who live a short distance north of the plant later complained of skin irritation. Laboratory tests of damaged vegetation revealed fluoride concentrations of more than 20 times the acceptable level. The estimated damage to plants extended two miles north of the plant.

14. Virginia, 1988

In 1988 a 61-year-old male was admitted to the hospital with complaints of pain in his lower extremities. He appeared extremely anxious, admitting that he had ingested an unspecified dose of "rat poison" (sodium fluoride) in a glass of water the prior afternoon, but he denied suicidal intent. He reported experiencing nausea, vomiting, diarrhea, and severe abdominal pain for approximately 16 hours; however, the pain had subsided the morning of his appearance in the emergency room. The patient was administered fluids for dehydration and aluminum hydroxide gel for abdominal pain. Both serum and urine specimens were collected for toxicological analysis. His blood plasma had a fluoride level of 3.4 mg/L, which is slightly above the "lethal" dose. A psychiatric consultation was ordered and the patient was sent home. He fully recovered.

15. Virginia, 1988

In 1988, a 33-year-old woman was found lying dead in her bed by her husband upon his returning home from work. On the nightstand next to the bed the husband discovered a half empty, 1-lb container of blue colored roach powder, labeled, 95% sodium fluoride, a Styrofoam cup containing some of the powder, and a spoon with portions of the moistened powder adhering to the surface. The toilet, in a bathroom adjacent to the bedroom, contained a blue-colored vomitus. The police were immediately summoned and upon their arrival informed the husband that the powder was of no consequence and suggested he dispose of the items and flush the toilet. The history supplied by police contained no mention of the roach powder. During the autopsy, a gastroenteritis was observed, and other findings were unremarkable. Histopathology examination of the tissues did not reveal a cause for the woman's death. Specimens were collected and sent for toxicologic analyses, but blood fluoride tests were not made. Other tests revealed a fluoride concentration of 3.4 mg/L in the bile. It is suggested that the woman died from the high fluoride

concentration of SF inside the home was after re-entry, because it was not measured.

13. Old Ocean, Texas, 1988

Hydrogen fluoride (HF) escaped from the refinery at the Phillips Petroleum Company on October 30, 1988, at Old Ocean, Texas. HF is an unstable gas that is produced as a refinery byproduct. (Hydrofluoric acid is a liquid form of hydrogen fluoride.) The fluoride compound is toxic to grazing animals and turns plants brown. Although there were no initial reports of injury, two women who live a short distance north of the plant later complained of skin irritation. Laboratory tests of damaged vegetation revealed fluoride concentrations of more than 20 times the acceptable level. The estimated damage to plants extended two miles north of the plant.

14. Virginia, 1988

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concentration in the blood.

**16. Annapolis, Maryland, 1989**

On July 27, 1989, in Annapolis, Maryland, a 73-year-old male died when he was accidentally given a cup of liquid fluoride in a drugstore to wash down a penicillin pill. Apparently, the pharmacy clerk mistook the bottle of clear liquid for water. The container, which was in the refrigerator, was marked stannous fluoride on the back of the bottle. The man went into a coma shortly after drinking the fluoride and 10 days later died after his family decided to discontinue life support.

**17. Argentina, 1991**

On August 12, 1991, Mt. Hudson in southern Chile exploded with five eruptions in six hours, sending ash and fumes into large parts of Argentina. In response to reports that large numbers of sheep deaths were due to high fluoride levels from ash, an investigation was conducted by CDC in cooperation with the Office of U.S. Foreign Disaster Assistance. The results of this investigation were that many sheep deaths were possibly due to a complex set of environmental, topographical, and husbandry conditions, exacerbated by the presence of large amounts of volcanic ash. Fluorides were not a cause of death of the sheep.

**18. Hennepin County, Minnesota, 1991**

A 70-year-old woman, in 1991, in Hennepin County, Minnesota, drank two swallows of a rust removal agent containing 8% hydrofluoric acid. This was in the presence of her husband. She immediately complained of mouth and throat pain. She arrived at the emergency room approximately 40 minutes after the ingestion, and emergency treatment was started. In the next two hours, she was defibrillated 22 times for ventricular fibrillation. During this period she was given calcium gluconate and magnesium sulfate. Seven hours after ingestion, her pulse and blood pressure were back to normal. On the day after her discharge, the patient was witnessed again by her husband to have ingested two swallows of the same rust removal agent. Again she had mouth and throat pain, went to the hospital and underwent emergency treatment. Eight hours after admission everything was back to normal. Neurological examination at discharge was unchanged from that at admission.

**19. Marshall, Minnesota, 1992**

In 1992 in the town of Marshall, a 56-year-old man went to his kitchen for a late night peanut butter snack. Instead of peanut butter he mistakenly ate a tablespoon of a glass etching compound that contained 20% ammonium bifluoride and 13% sodium bifluoride. The container is similar in size to a common peanut butter jar and

the compound is also of a color and consistency similar to peanut butter. The patient admitted himself to a local emergency room after an approximate 1-hour episode of nausea and vomiting that immediately followed ingestion of the etching compound. Approximately 5 hours after admission, the patient became extremely restless and suffered cardiac arrest, with ventricular fibrillation, and died. Postmortem blood was analyzed for fluoride using the ion-specific electrode method, and yielded a value of 19 mg/L (normal range is 0.2 to 0.6 mg/L).

20. Chicago, Illinois, 1993

On July 16, 1993, three deaths and several illnesses were blamed on fluoride poisoning at the University of Chicago Hospital dialysis unit in Chicago, Illinois. The problem was the discharge of high fluorides from the exhausted deionization (DI) resin purification system. DI resin, when used alone, is an effective means of removing fluoride. However, exhausted DI resin always discharges acidic water, which unbinds any fluoride previously bound to the anionic resin portion of the beds - a "slug" of high fluoride is released. How high the level of fluoride released depends upon the size of the resin beds, the pH of the water, and the fluoride content of the incoming water. The pH of the city tap water is important; the lower the pH, the more likely a high discharge of fluoride will occur from the exhausted DI beds. It is important to note that in this case, the city records clearly show that the city water system was consistently maintaining the optimal fluoride level of 1.0 ppm throughout this incident.

21. Edgecombe County, North Carolina, 1993

An elementary school in Edgecombe County has a mouthrinse program using bubble gum flavored fluoride. On October 26, 1993, just after the 5th grade students had finished rinsing, one student became dizzy and developed a rash. She also was taking two kinds of prescribed drugs. The girl was taken to a regular physician and then an allergist. Her mother indicated that the child was highly allergic to other substances. She was removed from the school mouthrinse program. Several days later, the child became dizzy again and was taken to a local hospital, where the doctor said that the girl displayed the classic symptoms of an allergy to methyl paraben. The child recovered and it is believed that she was allergic to the medication she had been taken.

22. New York City, New York, 1994

On July 26, 1994, a bizarre incident, even by fluoride standards, occurred at Rockefeller University Laboratory in New York City. The lab is run by a world-famous molecular biologist whose research focuses on cellular and viral genes, the AIDS virus and other medical "mysteries". Several lab employees became sick with queasiness, nausea, and diarrhea after using the sugar in the lab for tea and coffee.

Thinking it was just food poisoning, they threw out the sugar, so no tests could be made later on this compound. Other unusual incidents followed for the next few days: Bunsen burners were left on, filling the lab with gas; some towels in a closet were set afire, etc.

On June 10, two threatening letters were found, telling two scientists they "better quit". Also, the letters stated, "I put SF in the sugar". This apparently was a reference to sodium fluoride. Two similar letters were delivered in the mail the next week, to the head of the university and the university at large. The police interviewed the 40 people who work in the lab, but no one was ever caught. No more incidents were reported.

23. Deltona, Florida, 1994

On Tuesday morning, September 6, 1994, a tanker truck spilled 4,500 gallons of fluorosilicic acid when its rear wheels fell off on the interstate highway near Deltona. About 2,300 people were evacuated from area homes and 46 to 50 people (mostly emergency personnel) were taken to a local hospital with complaints of skin and respiratory irritations. All, except for two police officers, were treated and released. The two officers were kept overnight after complaining of headaches and burning in their throats. Hazardous waste experts dumped bags of lime and potash over the contaminated area to neutralized the acid and vacuumed the residue with special machines.

It is believed that a very small leak in the tanker caused the corrosive acid to eat away on the frame of the truck, causing the rear wheels to break loose.

24. Tokyo, Japan, 1995

On Monday, March 20, 1995, a deadly nerve gas spread through the Tokyo subway system, killing 10 people and sickening 5,000 others. The gas, Sarin, was developed by German scientists during World War II. Twenty times as deadly as potassium cyanide, it a compound of organic phosphorus, alcohol, sodium fluoride and other chemicals. A Buddhist cult was responsible for the attack. Because sodium fluoride is in this compound, this issue has surfaced in several fluoridation campaigns.