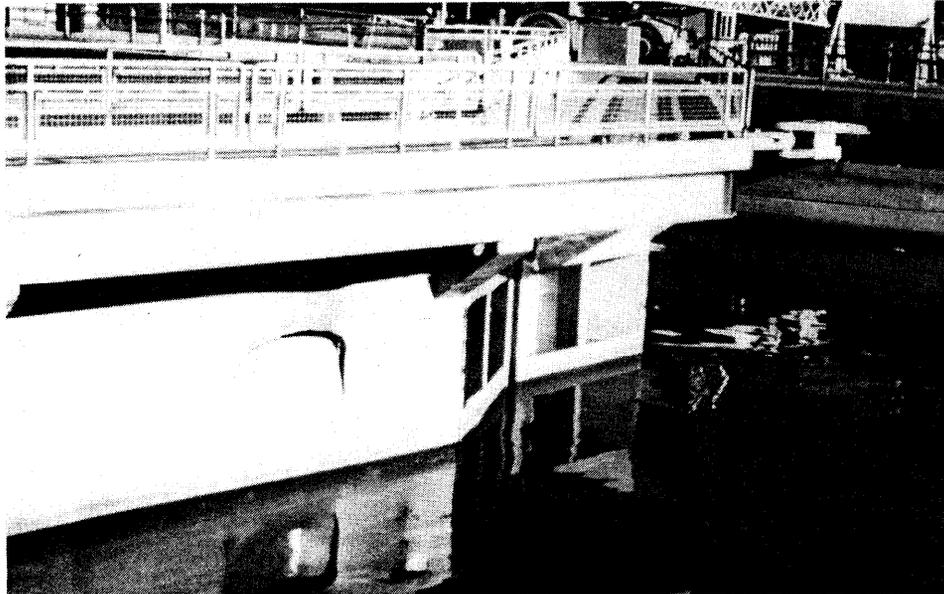




## REMR TECHNICAL NOTE HY-N-1.7

### LOCK ACCIDENT STUDY - CONTENTS AND FINDINGS



Barges in the upstream approach drifted into this mitergate at Pickwick Lock on the Tennessee River causing an estimated \$35,000 of damage to the skin plate

PURPOSE: To provide information on navigation accidents at selected locks and identify those locks with high accident rates and large repair costs.

BACKGROUND: Seven Corps of Engineers District offices were surveyed. Accident data reflecting the severity and frequency of vessel collision to Corps of Engineers lock facilities, specifically miter gates were collected. The data represents the direct costs of repairs for accidents involving collision of tows with locks.

The study was conducted by Dr. Martin E. Lipinski of Memphis State University while under temporary assignment to the Waterways Experiment Station arranged under the provisions of the Intergovernmental Personnel Act of 1970.

DISCUSSION: Accident data included the lock name, date of the accident, the direction of the vessel, whether a miter gate was struck, which miter gate was struck, and the amount of damage to government property. Analysis of the data identifies locks in the Upper Mississippi and Ohio River systems that are accounting for high accident rates and significant repair costs. Dollar damages reflect actual repair figures, when possible, or estimated damages if actual repair costs were not provided. Accidents reported without damage estimates were not included.

Table 1 summarizes the accident statistics by district. St. Paul District has the greatest number of accidents for the ten year period, while the St. Louis

Table 1  
Summary Statistics of Lock Accidents by District

<u>District</u>	<u>Total Years of Data</u>	<u># of Locks</u>	<u>Total # Acc.</u>	<u>Acc. Per Lock (#)</u>	<u>Cost Per Acc (\$)</u>	<u>Cost Per Lock (\$)</u>
St. Paul (NCS)	10	13	171	13.2	6,600	86,200
Rock Island (NCR)	9	20	144	7.2	33,600	241,600
Huntingdon (ORH)	10	9	119	13.2	23,700	313,200
St. Louis (LMS)	8	5	98	12.3	18,700	365,500
Louisville (ORL)	8	11	60	7.5	14,500	79,200
Pittsburgh (ORP)	7	15	59	8.4	10,900	42,800

District spent the most money per lock on repairs. Rock Island has spent almost half-a-million dollars per year making repairs to its locks which were damaged by collisions.

The 10 locks (of 73 surveyed) with the greatest number of miter gate accidents and the most accidents per year are found in Table 2, ranked in descending order according to the lock with the most miter gate accidents. While the average number of accidents per year is relatively low even at the high-accident locations, the damages associated with each accident can be quite costly, as seen in Table 3. Ranked according to miter gate damages, these statistics are based on locks having a minimum of five accidents during the period of record and include accidents which resulted in damages of less than \$1,000. Economic evaluation data are presented in Table 4, showing the average annual damages for the top ten locations for miter gate accidents. Other statistics and facts taken from the data such as the total number of accidents, the number of accidents to the miter gates, total expenditures for these six districts, etc, are shown in Table 5.

CONCLUSIONS: The miter gate accidents constitute 58.5% of the total number of accidents for the period of record represented by the survey. The average miter gate accident costs more to repair than other accidents. In fact, 80 percent of the catastrophic accidents (those > \$100K) occur to the miter gates. The 24 accidents in this category, or less than 4 percent of all the accidents reported, caused 50 percent of all the damages reported. If accidents of less than \$1,000 are assumed to be insignificant, the average cost per accident is dramatically increased as seen in Table 5, while the accident rate (#/lock/yr) is lowered from 1.03 to 0.35 (based on the average period of record of 8.7 years).

Investigation of these tables can help identify locks where protection systems or modifications could potentially provide savings. Four locks which have high accident rates per year, high average accident costs, and high average annual damages are Gallipolis, Lock and Dam 24, Lock and Dam 25, and Lock and Dam 22. (Tables 2, 3, and 4). Gallipolis Lock on the Ohio River, which had the highest accident rate and the highest annual damages, is presently being

Table 2  
Locks with the Most Accidents

<u>Lock Name</u> <u>(River)</u>	<u>District</u>	<u># Acc</u>	<u># Acc/Yr*</u> <u>(Miter Gates Only)</u>	<u># Acc</u>	<u># Acc/Yr*</u> <u>(All Accidents)</u>
Gallipolis (Ohio R.)	ORH	33	3.3	52	5.2
Lock and Dam 9 (Upper Miss. R.)	NCS	27	2.7	29	2.9
Lock and Dam 8 (Upper Miss. R.)	NCS	19	1.9	21	2.1
Lock and Dam 24 (Upper Miss. R.)	LMS	18	2.25	26	3.25
Lock and Dam 22 (Upper Miss. R.)	NCR	18	2.0	25	3.13
Lock and Dam 27 (Upper Miss. R.)	LMS	16	2.0	21	2.63
Lock and Dam 6 (Upper Miss. R.)	NCS	15	1.5	17	1.7
Lock and Dam 25 (Upper Miss. R.)	LMS	14	1.75	29	3.63
Lock and Dam 3 (Upper Miss. R.)	NCS	14	1.4	26	2.6
Lock and Dam 7 (Upper Miss. R.)	NCS	13	1.3	13	1.3

\* Rate of accidents based on Table 1 period of record.

replaced by two larger lock chambers with an improved alignment or approach to the locks. The other three high cost/high accident locks are on the Mississippi River and experience heavy traffic volumes which may account for the high rate of accidents at these locks.

The data provided by this study could be useful in investigations relating to lock performance. Data collected for this study are stored on diskette and are available upon request.

Table 3  
Locations Having Highest Average Cost Per Accident

<u>Lock Name (River)</u>	<u>District</u>	<u>\$/Acc. Miter Gates Only</u>	<u>\$/Acc. All Accidents</u>
Lock and Dam 21 (Upper Miss.)	NCR	134,560	85,570
Lock and Dam 17 (Upper Miss.)	NCR	117,060	96,450
Willow Island (Ohio)	ORH	72,410	52,080
Meldahl (Ohio)	ORH	49,930	35,760
Lock and Dam 25 (Upper Miss.)	LMS	47,810	24,410
Gallipolis (Ohio)	ORH	45,280	33,610
Lock and Dam 12 (Upper Miss.)	NCR	42,670	43,710
Lock and Dam 15 (Upper Miss.)	NCR	40,700	36,950
Lock and Dam 24 (Upper Miss.)	LMS	37,870	26,690
Lock and Dam 22 (Upper Miss.)	NCR	26,420	36,610

Table 4  
Top Locations With Highest Average Annual Damages to Miter Gates

<u>Lock Name (River)</u>	<u>District</u>	<u>Average Annual Damages (\$)</u>
Gallipolis (Ohio)	ORH	149,430
Lock and Dam 17 (Upper Miss.)	NCR	104,060
Lock and Dam 24 (Upper Miss.)	LMS	85,200
Lock and Dam 25 (Upper Miss.)	LMS	83,680
Lock and Dam 21 (Upper Miss.)	NCR	74,760
Lock and Dam 22 (Upper Miss.)	NCR	52,800

(Continued)

Table 4 (Concluded)

<u>Lock Name (River)</u>	<u>District</u>	<u>Average Annual Damages (\$)</u>
Meldahl (Ohio)	ORH	49,930
Lock and Dam 9 (Upper Miss.)	NCS	46,420
Lock and Dam 52 (Ohio)	ORL	45,670
Peoria (Illinois)	NCR	44,720

Table 5  
Fact Sheet

	<u>Miter Gates</u>	<u>All</u>
# Districts		6
Reporting Period		7-10 Years
# Locks		73
# Accidents	381	651
# Accidents Having Damages > \$100K	24	30
# Accidents Having Damages < \$1K	138	225
Total Repairs for Period	\$8,648,000	\$12,113,000
Total Cost of Accidents > \$100K	\$6,049,600	\$7,448,400
Avg Cost Per Accident	\$22,700	\$18,600
Avg Cost Per Accident of Acc. > \$1K	\$35,000	\$28,000