4.4 ANALYSIS OF POSSIBLE ERRORS IN HAZARDOUS LIQUID DATABASES

Some data elements in the accident report can be compared and examined for consistency. A simple illustration for the above statement is that the diameter of the pipe must always be larger than the wall thickness. If in a certain record (report) this is not true, it means that there is an error. It is suggested that if such an error is found, the entire report should be re-examined.

A consistency analysis of the nature that was just described above is presented in this section. Each analysis starts with the logic of the inquiry, followed by NJIT's findings.

1. **Comparing the amount of barrels lost in an accident to the number of barrels that were recovered.** One would not expect that an operator could recover more commodity than spilled.

   In database LIQLCK the following records show that more product was recovered than lost.

RPTID	LOSS	RECOV	RECOV-LOSS
890052	0	1700	1700
940007	0	600	600
870068	100	600	500
870039	15	148	133
920202	0	62	62
880127	50	103	53
930067	30	62	32
870040	0	5	5
880203	0	3	3
920178	0	3	3

   Database LIQUID does not include a requirement to report the amount of commodity that was recovered. Thus, this analysis cannot be performed for LIQUID.

2. **Comparing the pressure at the time of the accident (ACPRS) to the design pressure (DSPRS).** DSPRS is equivalent to the term maximum allowable operating pressure that is used in gas pipelines.

   The following table shows the percent of the accident pressure with respect to the design pressure. The table presents all the reports that had more than 100% accident pressure even though a surge pressure of 110% is acceptable for an operational practice standpoint. One could assume that an operation error could increase the pressure at the time of the accident to a threshold of, say, 50% above the design pressure (150% in the table). Thus, values that are within the threshold could be acceptable and should have a cause code equal to three (3) which is defined as incorrect operation by carrier personnel. Percentages which are larger than the

threshold are probably reporting errors. One should re-examine why the reports shown in the table below have a very large pressure compared to the design pressure and/or why the cause for many of these reports are not categorized as (3).

DATABASE LIQLCK

RPTID	CAUSE	DSPRS	ACPRS	PERCENT OF ACPRS/DSPRS
890043	1	10	100	1000%
920030	7	140	1200	857%
890089	3	100	500	500%
940196	2	250	600	240%
860165				182%
930137				151%
890139		1200	1800	150%
930152				150%
860154		960	1380	144%
890077	A	500	690	138%
890051	4	1150	1561	136%
920227	5	1100	1480	135%
870194	1	300	400	133%
910160	1	936	1234	132%
880203	1	1000	1285	128%
940097	6	700	890	127%
860103	3	600	760	127%
860004	1	621	766	123%
860082	1	450	520	116%
900035	3	1200	1370	114%
870175	5	200	228	114%

RPTID	CAUSE	DSPRS	ACPRS	PERCENT OF ACPRS/DSPRS
860059	3	1050	1180	112%
930165	1	179	200	112%
940108	4	1054	1155	110%
870025	1	580	630	109%
880172	4	936	1000	107%
930211	6	1440	1535	107%
870241	4	870	925	106%
920053	7	800	850	106%
880125	1	1025	1080	105%
880033	1	701	738	105%
870015	4	1171	1220	104%
860032	3	1200	1245	103%
870244	4	870	900	103%
870245	4	870	900	103%
920118	6	750	775	103%
860039	1	950	980	103%
920107	3	700	720	103%
900071	4	560	575	103%
870113	4	1080	1096	101%
900033	7	1440	1460	101%

DATABASE LIQUID

	CAUSE	DSPRS	ACPRS	Percent of ACPRS/DSPRS
700160	2	13	1040	8000%
690293	5	14	250	1786%
710247	1	31	329	1061%
810232	5	20	40	200%
800234	1	78	150	192%
810210	6	1440	2600	181%
680198	6	400	650	162%
750100	3	600	957	160%
680170	1	550	875	159%
780249	3	533	800	150%
720069	2	1200	1775	148%
760148	3	1400	2000	143%
760069	3	570	800	140%
730257	3	1195	1632	137%
710023	6	1296	1750	135%
710065	1	1120	1500	134%
830075	3	712	950	133%
780068	6	600	800	133%
730255	6	619	800	129%
720111	2	1200	1540	128%
820022	6	1150	1475	128%
740084	3	820	1050	128%
720094	2	1200	1520	127%
720101	2	1200	1520	127%

	CAUSE	DSPRS	ACPRS	Percentof ACPRS/DSPRS
740158	3	1200	1520	127%
720132	6	1188	1502	126%
720011	6	1732	2182	126%
850116	3	860	1075	125%
810207	1	1650	2060	125%
680370	1	1000	1230	123%
820056	3	734	900	123%
700303	3	1536	1880	122%
740082	6	860	1050	122%
810208	1	1650	2000	121%
720093	2	1200	1450	121%
830039	3	1185	1426	120%
790123	3	585	692	118%
680272	4	1690	1995	118%
680105	6	1190	1400	118%
680283	4	1690	1982	117%
820160	3	741	869	117%
690072	3	990	1150	116%
810179	6	716	825	115%
710134	3	1200	1380	115%
690043	1	1440	1647	114%
690213	6	1406	1600	114%
690202	3	715	809	113%
760091	6	700	791	113%

	CAUSE	DSPRS	ACPRS	ACPRS/DSPRS
740184	2	1200	1350	112%
700162	1	720	800	111%
840028	6	450	500	111%
690192	6	1170	1300	111%
700130	6	1080	1200	111%
680344	1	1200	1325	110%
820140	6	900	990	110%
760097	4	1716	1885	110%
820187	1	275	302	110%
790103	2	585	635	109%
800015	6	860	930	108%
720165	4	1715	1845	108%
760143	1	1111	1190	107%
800066	3	658	702	107%
740152	4	583	620	106%
760129	2	950	1010	106%
790189	3	1150	1216	106%
680152	6	1168	1230	105%
710153	6	1752	1845	105%

	CAUSE	DSPRS	ACPRS	Percentof ACPRS/DSPRS
680169	1	1000	1050	105%
770146	3	1250	1310	105%
790021	6	860	900	105%
850036	1	584	610	104%
740208	6	1694	1763	104%
760154	6	550	570	104%
800221	4	1694	1750	103%
700345	3	775	800	103%
700045	3	585	603	103%
710121	4	1354	1390	103%
800065	3	658	670	102%
790066	2	1170	1187	101%
760041	4	1550	1570	101%
720139	4	1252	1267	101%
840181	5	1500	1512	101%
700118	3	836	840	100%
800252	1	779	780	100%

3. **Unreasonable values for Nominal Diameter (NMDIA) and Wall Thickness (THK).** The criteria for this analysis was searching for nominal pipe diameter that is less than 1 inch or nominal diameters that are larger than 48 inches. The reason for selecting less than 1 inch as a minimum criteria was that we were looking for definite errors. One can make a case to set the minimum value to less than four inches and not risk being unreasonable. Two records that are outside of this range are listed below. The nominal diameter of the second row in the following table should probably read 12.75 inches.

DATABASE LIQLCK

RPTID	NMDIA	THK
900143	0.5	0
920221	12750	0.203

No errors have been found in database LIQUID.

4. **Comparing the extent of the damage and the operating capacity.** The capacity in this context is the ratio of the percent of the actual pressure, at the time of the accident, to the design pressure of the pipe. One would expect that when operating at very low capacity the extent of the damage will be limited. The following tables present accidents with property damage of $100,000 or more and in which the actual pressure was 40% or less than the design pressure. As one can see, some of the very costly accidents occurred at less than 10% of the capacity. These reports should be re-examined for accuracy of information. It should be noted that the $25,000,000 accident in the **LIQLCK** database was corrected by the **ASME** committee to $25,000.

DATABASE LIQLCK

RPTID	PROP. DAMAGE	CAPACITY	DSPRS	ACPRS
920141	$25,000,000	7%	1177	80
940048	$12,000,000	33%	822	270
930065	$3,000,000	26%	1264	325
860110	$2,350,000	36%	975	350
870046	$1,108,000	21%	1440	300
930100	$983,000	7%	1440	100
850152	$900,000	30%	624	185
860049	$800,000	21%	1440	305
880120	$735,000	29%	682	200
930124	$650,000	16%	1450	235
940132	$650,000	30%	1200	355
900062	$648,066	17%	580	100
870186	$500,000	3%	1350	45
930012	$500,000	35%	1716	600
890121	$500,000	32%	1400	450
880155	$500,000	3%	480	12
860150	$500,000	18%	750	135
890061	$500,000	8%	1298	100
940172	$425,000	1%	1400	15
910219	$412,000	13%	1485	200
930222	$400,000	3%	1440	42
930067	$360,000	26%	743	195
920230	$300,000	10%	1440	150
870008	$300,000	35%	570	200
900164	$300,000	2%	1440	30
880134	$262,410	29%	1440	420
870111	$250,000	22%	1150	250
920191	$250,000	30%	430	130
940128	$250,000	6%	687	40

RPTID	PROP. DAMAGE	CAPACITY	DSPRS	ACPRS
940144	$250,000	23%	901	210
880151	$250,000	37%	960	353
940099	$230,000	19%	930	180
860047	$229,600	3%	1400	45
920160	$226,000	0%	1440	4
910056	$225,000	24%	4369	1055
890083	$200,000	20%	900	181
910066	$200,000	23%	650	150
910158	$200,000	31%	650	200
880171	$175,000	11%	450	50
920214	$170,000	20%	720	147
880121	$165,300	25%	1200	300
930180	$152,184	23%	1130	256
900131	$152,000	20%	876	171
890012	$150,000	1%	668	4
870199	$132,326	29%	1650	485
910128	$130,000	25%	150	38
900111	$127,680	12%	850	100
890016	$125,000	31%	1440	450
910079	$125,000	21%	1450	300
870104	$118,000	16%	1080	168
890003	$116,053	25%	1440	367
870240	$105,000	13%	1440	185
930136	$105,000	32%	795	255
890076	$104,104	22%	1208	262

DATABASE LIQUID

RPTID	PROP. DAMAGE	CAPACITY	DSPRS	ACPRS
780178	$1,928,635	35%	1850	653
740193	$370,000	35%	1440	500
730011	$250,000	12%	200	24
780210	$200,000	2%	2130	40
800011	$175,050	20%	1062	210
830107	$170,160	34%	1632	555
780222	$170,000	29%	1339	390
750083	$151,000	16%	1694	277
800224	$150,000	31%	2294	700

RPTID	PROP. DAMAGE	CAPACITY	DSPRS	ACPRS
850099	$128,150	25%	1632	400
850042	$127,900	31%	1440	450
830074	$121,150	8%	1299	100
810215	$115,000	31%	2294	700
820164	$110,000	14%	1000	140
830015	$110,000	14%	1000	140
780120	$108,432	24%	2110	500
790140	$104,500	25%	2170	550

5. **Comparing the extent of the damage and the size of the spill.** Accidents that result in very large property damage are expected to be associated with either a large spill or with injuries and/or fatalities. The following tables shows accidents that caused property damage in excess of $500,000 for database **LIQLCK** and in excess of $250,000 for database LIQUID, a loss of less than 1000 barrels and without fatalities or injuries. One should question why was the damage assessed to be so high given the circumstances described above?

DATABASE LIQLCK

RPTID	Prop. Damage	LOSS
920141	$25,000,000	600
920149	$11,000,000	150
910033	$7,500,000	690
870070	$4,000,000	715
920163	$2,000,000	0
920031	$1,836,014	0
930107	$1,500,000	1
920074	$1,244,000	933
870046	$1,108,000	90
940205	$1,000,000	0
900152	$1,000,000	60
930185	$1,000,000	625
920088	$1,000,000	50
870229	$991,100	70
930100	$983,000	50

RPTID	Prop. Damage	LOSS
920170	$900,000	261
850152	$900,000	10
860049	$800,000	500
920053	$800,000	137
930004	$750,000	645
920084	$708,000	400
860152	$700,000	409
910121	$650,000	1
930124	$650,000	903
940132	$650,000	537
930118	$591,000	970
920099	$535,000	165
910095	$530,000	269

DATABASE LIQUID (TOTAL PROPERTY DAMAGE OF $250,000)

RPTID	Prop. Damage	LOSS
760104	$2,814,303	80
790087	$1,000,000	200
770173	$750,000	25
760172	$750,000	0
810222	$750,000	45
690020	$750,000	200
830036	$680,575	80
770066	$530,000	143
780015	$500,000	1

RPTID	Prop. Damage	LOSS
790059	$450,000	907
770142	$450,000	20
810143	$400,000	785
830126	$400,000	250
740193	$370,000	250
770204	$330,069	885
850098	$300,000	0
840035	$300,000	10
840050	$285,000	775

6. **Other unreasonable values.** The following is a list of data values that are recorded in the hazardous liquid databases and need to be verified.

DATABASE LIQLCK

RPTID	Field	Value	Field description (if necessary)
940103	SMYS	350000	
940085	THK	3.12	Wall thickness (should be 0.312?)
910056	DSPRS	4369	Design pressure
890062	TSTMM	14	Month of pressure test (12 is max.)
890058	TSTMM	14	
890063	TSTMM	19	
890064	TSTMM	22	
890059	TSTMM	23	
890110	TSTMM	30	
930122	TSTMM	38	
930121	YOR	1919	Year of report

DATABASE LIQUID

RPTID	Field	Value	Field description (if necessary)
700207	LOSS	223183	Amount of commodity lost
820172	THK	2.37	Wall thickness (should be 0.237?)

850130	THK	1.25	Wall thickness (should be 0.125?)
780212	COV	600	Depth of cover (more than 20 ft.)
780014	COV	569	
780203	COV	360	
830091	COV	301	
730286	COV	297	
780025	COV	250	
770173	COV	250	
700131	DSPRS	9900	Design pressure (seems very large)
800105	DSPRS	4320	
720243	TSTMM	61	Pressure test month (12 max.)
810239	TSTYY	96	Pressure test year (1996?)
790161	DSTLM	4691300	Distance to nearest line marker (?)
680325	DSTLM	89760	
810106	DSTLM	56496	
730213	DSTLM	26400	
770148	DSTLM	20592	
680335	DSTLM	18000	
680363	DSTLM	11616	
770202	DSTLM	11560	
680357	DSTLM	11088	
740060	DSTLM	10560	
710084	DSTLM	10560	

Samples of tables that were used for data integrity analysis are enclosed in Appendix B-4 of this report.

4.5 DATA CORRECTIONS

In order to correct data (any data) one must have substantial confidence that the new value that is assigned is correct. There is no reason to replace one questionable value by another. Another aspect of correcting data is that one can make a case for correcting the data if the correction will have a statistical impact on the results. If the change in value will not change the results of the statistical inference, correcting the data becomes less pressing. Nevertheless one should always maintain correct data and strive to correct all the errors.

In the case of hazardous liquid databases it was felt that there was not enough information to replace incorrect data by other values. It was also felt that for the analysis of the data performed under this contract there will be no significant change in the results if a few values are replaced. Thus, only minor corrections have been made to the databases. The corrections that were made are:

- Eliminating duplicate records.
- Replace the damages in report ID No. 920141 from $25,000,000 to $25,000.

OPS, in cooperation with the individual operators, is encouraged to investigate the possible data problems that were indicated in this report and correct the databases.

5.0 DATA DEFICIENCIES

5.1 ADDITIONAL INFORMATION ASPECTS

ANNUAL REPORT

The major deficiency of data in hazardous liquid pipeline reporting is the lack of detailed annual reports on the operation of the industry. Gas transmission companies are required to file an annual report in which they are requested to specify the characteristics of their system per mile of operation. An annual hazardous liquid report should contain information on:

- Cathodic protection
- Coating
- Pipe diameter
- Wall thickness
- Type of pipe, including grade and year of installation
- Type of pipe (or welding) joint
- Prevention programs
- Pigging activities

The information should be gathered on a per mile basis so that normalization of the data will be possible. Without this data, any attempt to arrive at statistically valid findings which are based only on the accident information is not possible. A questionnaire that includes the above needed information is presented in the next Chapter.

ACCIDENT REPORTS

Other information that should be included on the accident report form is:

Pipeline material properly - Essentially, the grade of the pipeline

Local land use policy - To better understand the impact of accidents.

5.2 NORMALIZATION ASPECTS

The need for normalization of the data will be illustrated by the following example:

When the cause of an accident is determined to be due to corrosion the operator is required to specify whether the failed pipeline was coated and whether it had cathodic protection. This information could be used to determine the effectiveness of, and/or the necessity of protecting the pipeline by this measure. In LIQLCK database one can find that over 90% of the pipelines in which an accident occurred were cathodically protected. What does it mean? Does it mean that pipe that is not cathodically protected is safer? If only less than 10% of the accidents occur on this pipe, one may come to such an erroneous conclusion. However, if one has information that 99% of the pipe is cathodically protected the normalized conclusion will be that this pipe is less prone to corrosion failure. If 99% of the pipe is cathodically protected it means that unprotected pipe is subject to corrosion 10 time more than protected pipe. The logic behind this

conclusion is that since the unprotected pipe constitutes 1% of the system one would expect only 1% corrosion failures on this pipe, not 10%. Thus, the ability to draw valid conclusions depends on whether or not the data can be normalized.

Data for normalization is very important for a risk analysis process. One needs to know how much pipe of a specific grade, with a specific type of pipe joint, in a certain type of soil, has a history of accidents. Trends and prediction of potential problems must be based on normalized (or averaged) information, not on raw data.

What information needs to be normalized and where can we obtain this information? The answer is to adopt an annual report form for the hazardous liquid pipeline industry which will include at the minimum the information which is outlined in the questionnaire presented in the next Chapter.

6.0 QUESTIONNAIRES FOR HAZARDOUS LIQUID PIPELINES

The following is a data collection instrument that would collect essential data for analyzing risks associated with hazardous liquid pipelines. The goal for implementing this instrument is that each operator submit the requested information on a one time basis with annual updates of changes.

L1 PLEASE INDICATE THE MILES (OR PERCENTAGE OF THE SYSTEM) OF PIPELINE IN YOUR SYSTEM WHERE STATUTORY ONE-CALL SYSTEMS, MANDATORY AND VOLUNTARY ARE UTILIZED AND NOT UTILIZED FOR THE YEARS INDICATED.

MILES OF PIPELINE IN THE SYSTEM

YEAR	MANDATORY ONE-CALL	VOLUNTARY ONE-CALL	NO ONE-CALL	TOTAL PIPELINE MILES IN SYSTEM
1970				
1971				
1972				
1973				
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995				

These data would be part of the annual report form to allow for the normalization of the analysis of accident data.

L2 PLEASE INDICATE THE PERCENTAGE OF THE SYSTEM WHICH IS PIGGABLE AND MILES OF PIPELINE IN YOUR SYSTEM WHERE PIGGING IS PERFORMED BY YEAR AND LEVEL OF SENSITIVITY OF THE INSTRUMENT UTILIZED.

YEAR	MAGNETIC FLUX	MAGNETIC FLUX SENSITIVITY	GEOMETRIC INSTRUMENT	GEOMETRIC SENSITIVITY	PIGGABLE % OF SYSTEM
1970					
1972					
1973					
1974					
1975					
1976					
1977					
1978					
1980					
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988					
1989					
1990					
1991					
1992					
1993					
1994					
1995					

These data would be part of the annual report form to allow for the normalization of the analysis of accident data.

L3 **INDICATE FOR EACH REPORTED ACCIDENT FOR THE PERIOD 1983 THROUGH 1995, THE FOLLOWING INFORMATION ON THE ACCIDENT.**

DATE OF ACCIDENT	RPTID OF ACCIDENT[1]	PIGGED PRIOR TO ACCIDENT (Y/N/NP[2])	DATE OF PIGGING	TYPE OF PIG

These data would be used to supplement accident report form.

[1] Report ID in OPS form

[2] NP=Accident Location is not piggable

L4 PLEASE ESTIMATE THE MILES OF PIPELINE IN YOUR SYSTEM BY ENVIRONMENT FOR THE YEARS GIVEN IF THE DATA IS REASONABLY AVAILABLE.

MILES OF PIPELINE IN THE SYSTEM

1971					
1972					
1973					
1974					
1975					
1976					
1977					
1978					
1979					
1980					
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988					
1989					
1990					
1991					
1992					
1993					
1994					
1995					

These data would be part of the annual report form to allow for the normalization of the analysis of accident data.

L5 PLEASE INDICATE THE MILES OF PIPELINE IN YOUR SYSTEM WHERE MAXIMUM OPERATING PRESSURE, DIAMETER, THICKNESS, SPECIFICATION, GRADE AND MOST RECENT TEST PRESSURE HAVE UNIFORM CHARACTERISTICS. ALSO INDICATE THOSE VALUES FOR EACH YEAR FROM 1970-1994. A SAMPLE RESPONSE IS SHOWN IN ITALICS. THIS QUESTION WILL ALLOW MORE SOPHISTICATED METHODS TO BE USED IN DATA ANALYSIS.

MILES OF PIPELINE IN THE SYSTEM

MOP	Pipe Diam	Wall Thick	Pipe Spec	Pipe Grade	Test Pressure	Miles of Pipe	Years at This Value
975 psi	*36"*	*0.312"*	*API*	*X 52*	*648 psi*	*18.4 mi*	*'70-'89*

These data would be used to supplement the accident report form.

L6 PLEASE INDICATE THE MILES OF PIPELINE IN YOUR SYSTEM BY DATE OF CONSTRUCTION FOR THE YEARS SHOWN IN THE TABLE.

MILES OF PIPELINE IN THE SYSTEM

YEAR	PRIOR TO 1940	1940 THRU 1949	1950 THRU 1959	1960 THRU 1969	1970 THRU 1979	1980 THRU 1989	1990 THRU 1999	NOT KNOWN
1970								
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987								
1988								
1989								
1990								
1991								
1992								
1993								
1994								
1995								

These data would be part of the annual report form to allow for the normalization of the analysis *of* accident data.

L7 PLEASE INDICATE THE FLYERS DISTRIBUTED (SAMPLE AND NUMBER) AS WELL AS THE OTHER PRACTICES UTILIZED BY YOUR COMPANY, IN GENERAL (E.G., MEETINGS, ETC.), TO EDUCATE THE PUBLIC AS TO THE PRESENCE OF HAZARDOUS LIQUID PIPELINES IN THEIR NEIGHBORHOOD AND THE MILES OF PIPELINE ASSOCIATED WITH EACH PRACTICE, BY YEAR, FROM 1970 THROUGH THE PRESENT.

These data would be part of the annual report form to allow for the normalization of the analysis of accident data.

L8 PLEASE INDICATE THE TRAINING PROGRAMS UTILIZED BY YOUR COMPANY FOR YOUR EMPLOYEES WITH REGARD TO SAFETY AND RISK REDUCTION, IN GENERAL, BY YEAR FROM 1970 TO PRESENT.

These data would be part of the annual report form to allow for the normalization of the analysis of accident data.

L9 PLEASE INDICATE THE MAPPING SYSTEM CURRENTLY USED BY MILE OF PIPE IN YOUR SYSTEM.

MANUAL DRAFTING	CAD	AM/FM	GIS

These data would be used to supplement the accident report form.

L10 PLEASE INDICATE THE TYPE OF MITIGATIONS (RISK AVOIDANCE MEASURES) CURRENTLY USED IN YOUR SYSTEM.

MITIGATION TECHNIQUE	YES CK.	NO CK.	FREQUENCY OF APPLICATION	% OF SYSTEM COVERED
MAG FLUX PIGGING				
ULTRA SOUND PIGGING				
CALIPER PIGGING				
AERIAL SURVEILLANCE				
GROUND SURVEILLANCE				
VISUAL LEAK DETECTION				
ACOUSTIC MONITORING				
HYDROSTATIC TEST				
CLOSE INTERVAL POTENTIAL SURVEY				
USE OF HIGH TOUGHNESS PIPES				
Other:				
Other:				
Other:				
Other:				

These data would be used to supplement the accident report form.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Regarding RSPA's Database on hazardous liquid accidents, the main conclusion of this appendix is that the existing reporting forms and recording procedures are inadequate for performing statistically significant conclusions on the cause and consequences of hazardous liquid pipeline accidents. This lack of data prevents arriving at definitive assessments of risks.

In order to enhance reporting requirements, it is recommended that an annual report be required for the hazardous liquid pipeline industry.

The process of inputting new data into the database needs to be reviewed as well. A quality control component to minimize errors in the database is needed. It is recommended that an electronic form be developed which will examine the validity of each input item.

The existing procedure in which the operator files the accident report without being audited (at least on a random basis) is also deficient. A mechanism is needed for checking the reported information for accuracy.

The recommendation proposed is to develop a comprehensive or a selective (random) auditing process of the accident reports.

Following these recommendations, NJIT is presently developing for DOT-OPS an electronic form that will significantly reduce input errors.