The oil companies' European association for Environment, Health and Safety in refining and distribution

concawe

Performance of European cross-country oil pipelines

Detailed description of reported spillages 1971 - 1983

Report No. 2/73

SPILLAGES FROM OIL INDUSTRY CROSS-COUNTRY PIPELINES IN W. EUROPE

Statistical Summary of Reported Incidents 1971

3.2 Number of Incidents [1]

A total of 35 incidents was reported for the 5 years' period mentioned above, or an average of 7.0 incidents per year. These were broken down as follows:

Years	Pipe-Line	Pump- and other Stations	Oil Spilled m3	Oil Recovered as such m3	Est. Oil Transport in Million m3
1967	3	2	33.2	0	224
1968	2	0	1.8	0.5	236
1969	3	3	61.5	45.0	248
1970	9	2	719.1	502.0	250
1971	7	4	2730.5	2667.0	310
Total	24	11	3546.1	3214.5	1268 (rounded off to 1.3 thousand million m3)

[1] For details of incidents which happened in the years previous to 1971 reference is made to CONCAWE Report no. 2/72.

DETAILED DESCRIPTION OF
OIL INDUSTRY PIPELINE INCIDENTS 1971

Restricted to w.g. OP

Incident Ref. No. for 1971	Quantity of oil spilled	Pipe ∅	Specification wall thickness	How discovered	Estimated Cost of repair and damage	Cause of Spill	Damage	Remarks
(1)	6 m³ light	8"	5.16 mm	Drop in pressure	Company repair	Corrosion		No water pollution.
PL	Virgin Naphta		1951		$ 1000. No damage to public property	CORROSION - external	None Measures 1): closure of block valves	Type of soil: sand/ gravel Measures 2): Increase in corrosion control devices. No recovery 3)
(2)	1,5 m³ light	8"	5.16 mm	Telephone con-	Company repair	Damage from outside	None, as LVN evap-	No water pollution. Type
PL	virgin naphta (LVN)		1951	tact	$ 900. No damage to public property	source (vandalism) EXTERNAL SOURCE - third party, vandalism	orated immediately. Measures 1): section valves closed	of soil: clay Measures 2): Police investigation in area for vandalism. No recovery 3)
(3) PL	1 m³ Heating Oil	10"	- 1968	Immediately by operator who was on site	Company repair negligible. Damage to public property $ 3800	Failure of a gasket between 600 lbs flanges (valve). Gasket assembly was recently and apparently incorrectly performed MAINTENANCE - improper practice	Damage includes loss of fruits (pears and apples) and buskes (strawberries)	No water pollution. The oil was sprayed over 4000 m² by the wind. Type of soil: agricultural soil (wheat and fruits). Measures 2): Tightening supervision of repairs made on line and fittings. No recovery 3)
(4)	Negligible	10¾"	9 mm	Spots of oil	Company repair	Defective weld.	No damage	No water pollution
PL				on the water of the river	NR. No damage to public property	DEFECT OF PIPE - weld circum.	Measures 1): stoppage of pumping and empting of line across the river.	(negligible). Measures 2): Reconstruction of Po-river crossing (600 m). No recovery 3)
(5)	4 m³ crude	-	-	By personnel	Company repair	When removing the plug	No damage	No water pollution
PS				attending the work	$ 3200 No damage to public property	of the Lock-O-Ring flange, a 3/8" screw broke out of one of the four segments. MAINTENANCE - improper practice	Oil was flowing into a concrete basin and pumped immediately into the relief tank.	Type of soil: Clay bottom in a concrete basin. The clay has been dug out. Recovered 4 m³

1~ measures taken to limit soil/water pollution

2 measures taken to limit this type of incidents in future

3 the (remainder of the) oil spilled has been disposed of in such a manner as to leave no harmful effect on the environment

PL = Pipeline - PS = Pumpstation

Incident Ref. No. for 1971	Quantity of oil spilled	Pipe ∅	Specification wall thickness	How discovered	Estimated cost of repair and damage	Cause of Spill	Damage	Remarks
(6) PS	25 m³ crude	-	-	By personnel attending the work	Company repair $ 4400. No damage to public property	After a shut down for a tie-in of the future pump station a motorized valve began to open and oil run through an open 6" nozzle into a pit. OPERATION - human failure	No damage. The oil was running into a pit which had been dug out for the tie-in.	No water pollution. Type of soil: Gravel with layer of clay. Oil had been pumped out immediately. A small amount of soil had been impregnated and was dug out. Groundwater was pumped out and cleaned in an oil separator. No remaining groundwater or soil pollution. Recovery 25 m³
(7) PS	350 m³ crude (within dikes)	34"	- since 1962	Company personnel	Company repair $ 7900. No damage to public property	Failure of telecommunications and electrical equipment causing overflow of a relief tank. EQUIPMENT FAILURE - controls and instruments	Tank roof to be repaired and dike to be cleaned. Measures 1): cleaning of the dike.	No water pollution. Type of soil: clay-lined Dikes Measures 2): modifications of the installation. Recovery 350 m³
(8) PL	2000 m³	34"	7.92 mm 1962	By contractor's personnel.	Company repair $ 57,000 Public damages $ 133,000	Movement of the ground due to parallel ditches for 2 new pipes made by contractor EXTERNAL SOURCE - landslides	2000 m³ of earth Drained up to complete cleaning. Measures 1): Trenches across the top – soil removed	No water pollution. Type of soil: clay and sand with stones. Measures 2): Drainage system has been installed after repair. Recovery about 2000 m3 3)
(9) PL	3 m³ heavy fuel oil	4 1"	3.58 mm API 5LX Grade X42 1965	Heavy fuel oil was seeping to the surface of the soil.	Company repairs $ 11,000 No damage to public property	Corrosion of the pipe due to stray currents. The soil contained chlorine salts from former salt storage. CORROSION - external	The leaking oil was spread over about 20 m². The pipe was dug out and repaired. No damage was caused. Measures 1): Replacement of the oil polluted ground	No water pollution. Measures 2): The surrounding ground which contained chlorine compounds was replaced by sand. The cathodic protection system will be checked daily. The oil could be re- Covered

1) measures taken to limit soil/water pollution
2) measures taken to limit this type of incidents in future
3) the (remainder of the) oil spilled has been disposed of in such a manner as to leave no harmful effect on the environment

PL = Pipeline - PS = Pumpstation

OIL INDUSTRY PIPELINE INCIDENTS 1971 (cont'd)

Restricted to w.g. OP

Incident Ref. No. for 1971	Quantity of oil spilled	Pipe ∅	Specification wall thickness	How discovered	Estimated Cost of repair and damage	Cause of Spill	Damage	Remarks
(10) PL	300 m^3 crude	20"	8.80 mm July 1966	By contractor	Company repair $ 40,000 Damage to public property $ 370.	Spill was caused by contractor's digging equipment. EXTERNAL SOURCE - third party accidental.	About 4000 m^2 of cultivated land was treated by "in situ" reclamation.	No water pollution. Measures 2): Improved inspection of the lines if third parties are at work near the pipeline. Recovery 250 m3 3)
(11) PS	40 m^3 crude	20"	7.70 mm 1966	Automatic detection	Company repair $ 375. Damage to public property $ 250	Failure of check valve joint in pumpstation. EQUIPMENT FAILURE - gasket or flange. (gasket in flanged joint)	Crude oil sprayed over 60,000 m^2 by strong wind. Measures 1): -	No water pollution. Type of soil: Concrete at station. Grass around station. Measures 2): all joints were renewed. Recovery: 35 m^3 3)
	2730.5 m^3				Repair: $ 125,775 Damage: $ 137,420			recovered as such: 2667 m3

1) measures taken to limit soil/water pollution
2) measures taken to limit this type of incidents in future
3) the (remainder of the) oil spilled has been disposed of in such a manner as to leave no harmful effect on the environment

PL = Pipeline - PS = Pumpstation

Report No. 1/74

SPILLAGES FROM OIL INDUSTRY CROSS-COUNTRY PIPELINES IN W. EUROPE

Statistical Summary of Reported Incidents 1972

3.2 Details of Spillage Incidents during 1972

Twenty-one spillages were reported during 1972 and these are itemised in detail in Appendix I, and further tabulated in categories and volumetric groups in Appendix II.

Of the twenty-one occurrences, only one related to a pump-station, and this resulted in the largest single spill during 1972 - 800 cubic metres, of which 650 cu. metres were subsequently recovered causing a net loss of 150 cubic metres. The accident was caused by the rupture of the longitudinal weld in a fabricated reducing bend on the discharge side of a series of four booster pumps, hence the large volume spilled.

Two further spills resulted from mechanical failure of equipment. One occurred through failure of a now obsolete type of above-ground insulating joint, and the other was caused by a defect in a piece of auxiliary equipment used during a maintenance operation.

Nine spillages occurred as a result of external corrosion and nine were caused by third-party damage. Seven of the last mentioned were direct ruptures by heavy excavation plant, and one by an abnormally deep ploughing operation. The sub-soil condition resulting from this latter activity severely restricted recovery of the spilled oil and this event produced the largest single net loss of 350 cubic metres.

The "Net Loss" tabulation shows that in no less than seven incidents all oil spilled was recovered as such; in four cases the net loss was less than one cubic metre, and in eight cases the net loss was between one and one hundred cubic metres. The two largest spills of 150 and 350 cubic metres have already received specific mention.

The table for "Clean-up Completion" indicates that in nine cases complete clean-up was achieved on the day of the occurrence, and in two cases on the following day. Seven sites were cleared within one week, and on only three occasions was it necessary to extend operations to ensure complete evaporation, dispersal, or disposal before declaring the area "clean".

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1972

REF. NO.	DATE	P/L OR P/STN.	GRADE OF OIL	QUANTITY IN CU.M SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN.	HOW DISCOVERED OR REPORTED	ESTIMATED COST DAM.& REPAIR-£	CAUSE AND CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
1	Jan.14	P/L	Crude	60	48	12	Jan.15	5LX-52 0.375 28"	Excavator driver	22,000	Third party damage Mech. excavator E(a)	Some contamination of arable soil	Local drainage channels only	Soil decontaminated and refertilized
2	Jan.31	P/L	HFO	0.9	0.8	0.1	Same day	5L-GR.A SCH. 40 6"	Third party	2,500	Corrosion C(a)	Young trees Damaged	Nil	Pipe section renewed Trees replaced
3	Feb. 3	P/L	Crude	250	150	100	Feb. 6	0.250 20"	Company personnel	7,300	Third party damage Mech. excavator E(a)	-	Ship canal	Pollution in tidal waters treated with oil dispersal spray
4	Fen. 7	P/L	HFO	0.45	0.45	Nil	Same day	5L-GR.A SCH. 40 4"	Third party	1,350	Corrosion C(a)	Nil	Nil	Pipe Section renewed
5	Feb.21	P/L	HFO	5	4	1	Same day	0.330 12"	Third party	1,150	Corrosion C(a)	Nil	Nil	Corrosion caused by salt water environm.
6	Feb.28	P/L	Gas oil	30	30	Nil	Feb.29	5LX-52 0.250 10"	Land owner	10,400	Third party damage Bulldozer E(a)	Nil	Nil	All oil contained by adjacent excavation & Subsequently recovered
7	Mar. 1	P/L	Gas oil	70	31	39	Mar. 3	5LX-46 0.250 12"	Farmer	5,450	Mechanical failure of gasket in exposed flanged joint A(b)	Some contamination of soil and drainage channels	4.5 cu.m in river All recovered	Comprehensive replacement programme for all insulating Gaskets
8	Mar. 3	P/L	Crude	200	140	60	Mar. 8	0.330 20"	Company personnel	11,000	Third party damage Mech. excavator E(a)	Nil	Ship canal	Oil in canal treated with dispersal spray
9	Mar. 4	P/L	Crude	40	5	35	Mar. 6	0.312 8"	Third party	3,000	Corrosion C(a)	-	Some contamination local drainage	-
10	Apr.26	P/L	Crude	90	90	Nil	Apr.30	5L-GR.B 0.250 10"	Dragline operator	1,700	Third party damage Mech. excavator E(a)	Nil	Nil	-
11	May 6	P/L	HFO	0.25	0.25	Nil	Same day	5LS-X42 0.250 12"	Third party	2,000	Corrosion resulting from third party damage E(c)	Nil	Nil	Damaged pipe insulation not reported at time by third party responsible

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1972

REF. NO.	DATE	P/L OR P/STN.	GRADE OF OIL	QUANTITY IN CU.M			CLEAN-UP COMPLETED	PIPE SPECN.	HOW OR REPORTED	ESTIMATED COST DAM.& REPAIR-£	CAUSE AND CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
				SPILLED	RECOVERED	NET LOSS								
12	Jul. 7	P/L	Gas-oline	99	3	96	end July	5L-X46 0.219 10"	Bulldozer driver	27,000	Third party damage Bulldozer E(a)	Contamination of arable soil	Nil	Spill contained by harrier trenches Clean-up period ex-tended to ensure satisfactory soil restoration
13	Jul.27	P/L	Crude	7	7	Nil	Same day	5LX-52 0.219 8"	Plant operator	3,700	Third party damage Bulldozer E(a)	Slight soil contamination	Nil	-
14	Aug. 31	P/L	Gasoil	400	50	350	Sep. 8	5LX-52 0.219 8"	Control room operator	7,000	Third party damage Deep ploughing E(a)	Soil contamination	Nil	Leakage indicated by C/R instrument-ation on resumption of pumping
15	Sep.14	P/L	Gas oil	150	100	50	-	5LX-46 0.250 10"	Control instrumentation	-	Corrosion C(a)	Some soil contamination	Nil	Local. C.P. deficiency under investigation
16	Sep.26	P/ L	Gas oil	5	5	Nil	Same day	5LX-52 0.344 16"	Company personnel	550	Mech. failure Auxiliary equipment A(b)	Nil	Nil	Rupture of small bore fitting during maintenance operation
17	Oct-16	P/ L	Gas oil	500	500	Nil	Oct.22	0.315 12"	Third party	900	Corrosion C(a)	Some ground contamination	Nil	Wholly within state property.No private land involved
18	Nov. 1	P/ L	Crude	10	5	5	Nov. 20	0.312 8"	Third party	-	Corrosion C(a)	_	_	Constructed 1943 C.P. applied 1960
19	Nov. 30	P/ L	Crude	1	-	1	Same day	5L-GR.B 0.375 10"	Company personnel	1,920	Corrosion above ground section C(a)	Nil	Refinery drainage system onlv	Section replaced with "coated pipe"
20	Dec. 5	P/STN.	Crude	800	650	150	Deo.16	0.550 28"	Instrumentation	90,000	Mech. failure Material fault A(b)	Some soil contamination	Some pollution of drainage & irrigation ditches	Defective weld seam an prefabricated bend fitted to pump discharge. Improved inspection procedures
21	Dec. 9	P/ L	Crude	1	-	1	Same day	5L-GR.B 0.375 10"	Company personnel	1,900	Corrosion C(a)	Nil	Nil	Section repaired. Pipe coated

CAUSE CATEGORY

MECHMCAL FAILURE

(a) Construction fault

(b) Materials fault

OPERATIONAL ERROR

(a) System malfunction

(b) Human. error

G. CORROSION

(a) External

(b) Internal

NATURAL HAZARD

(a) Lanaslide or subsidence

(b) Flooding
(c) Other

E. THIRM PARTY ACTIVITY

(a) Direct damage - accidental

(b) Direct damage - malicious

(C) Incidental damage

Report No. 5/74

SPILLAGES FROM OIL INDUSTRY

GROSS-COUNTRY PIPELINES IN W. EUROPE

Statistical Summary of Reported Incidents

1973

A Report by

The. Oil Pipelines Special Task Force No. 1

Prepared by

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Ph. Rogier

Stichting CONCAWE

The Hague

September 1974

3.2 Details of Spillage Incidents During 1973

Twenty spillages were reported during 1973. These are itemised in detail in Appendix I, and further tabulated in categories and volumetric groups in Appendix II.

Out of twenty occurrences, fifteen related directly to pipelines and five to associated pump stations. Of the latter, with one exception where slight contamination of an adjacent stream occurred, all were contained within the confines of the station concerned. The five station incidents all resulted from mechanical failure of associated equipment peculiar to such facilities, and which would not normally exist on buried section of cross-country pipelines. In several cases modifications were applied which would prevent recurrence of the specific type of failure experienced.

The fifteen spillages from pipelines were made up as follows:
Two mechanical failures, eight perforations due to external corrosion one fracture due to land subsidence, and four resulting from third party activity. The first mechanical failure was attributable to metal fatigue in an older type heavy fuel-oil pipe operating under varying temperature conditions, and the second resulted from a gasket failure on ancillary pipework. Five of the eight corrosion leaks occurred on a section of one of the older pipelines which was located in a particularly aggressive environment. The portion affected has now been replaced, and the remainder is being rapidly brought up to modern standards. The other three corrosion defects were also located on older systems where cathodic protection (C.P.) had not yet proved fully effective. The fracture due to land subsidence resulted from the collapse of mine workings. The mining industry is able to predict with considerable accuracy the area likely to be affected by, and the timing of, such earth movement, and close liaison with the authorities concerned will eliminate most of this type of hazard to buried plant. Nevertheless, additional precautions have been initiated by the pipeline operators themselves.

Of the four spills directly attributable to third party activity, one was physical damage inflicted by a mechanical excavator, and the remainder arose subsequently from incidental damage inflicted during second-comer construction, and which was not reported to the pipeline owner at that time.

The gross amount of product involved in the 20 spillages detailed was 1,154 cubic metres. Some 1,071 cubic metres were recovered on site and the net total loss for 1973 amounted to only 83 cubic metres, or an average of 4 cubic metres per incident. All oil spilled was recovered completely from 10 incidents, and nine required particular disposal or dispersal procedures for between 1 and 12 cubic metres. Only in the one remaining location was a sizeable loss sustained, and this amounted to 40 cubic metres in the area of land subsidence.

Five spillage areas were completely cleaned-up either on the same day, or the day following the occurrence; six were satisfactorily dealt with within one week; nine required site occupation averaging 24 days in order to ensure that dispersal or disposal was complete, and the area in acceptable condition to resume normal usage.

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1973

REF. NO.	DATE	P/L OR P/STN.	GRADE OF OIL	QUANTITY IN CU. M SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN.	HOW DISCOVERED OR REPORTED	ESTIMATED COST DAM.& REPAIR-£	CAUSE AND CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
1	Jan. 14	P/L	HFO	4	4	Nil	Feb. 6	5L-X42 0.141 4"	Line patrol	1,550	Mech. failure A(a)	Nil	Nil	Pipe steel fatigued by thermal cycling. Expansion loop installed.
2	Jan. 19	P/L	HFO	310	300	10	Feb. 5	GR. A SCH. 30 0.330 12"	Third party	10,500	Corrosion C(a)	Soil contamination	Nil	Pipe in tiled duct exposed to salt-air environment.
3	Feb• 7	P/L	HFO	0.3	0.3	Nil	Feb. 8	5LS-X42 0.250 12"	Adjacent P/L patrol	1,300	Third party activity E(c)	Nil	Nil	External corrosion resulting from damage to sleeve + thermal insulation
4	Feb.19	P/L	HFO	150	148	2	Mar. 9	GR. A SCH. 30 0.330 12"	Line patrol	3,000	Corrosion C(a)	Slight soil contamination	Nil	Localised corrosion at transition to above-ground section
5	Feb-23	P/L	HFO	15	15	Nil	Apr. 2	5L-X42 0.141 4"	Line patrol	3,250	Corrosion C(a)	Nil	Nil	Ineffective C.P. clean-up delayed for extensive checks
6	Mar. 5	P/STN.	Crude	25	22	3	Mar. 9	20"	Third party	1,400	Mech. failure A(a)	Slight soil contamination	Nil	Flange gasket failed Thermal relieve valve fitted
7	Mar.29	P/L	HFO	250	245	5	Apr.20	GR. A SCH. 30 0.330 12"	Third party	6,850	Corrosion C(a)	Soil contamination	Nil	Corrosion inside thermal insulation on above-ground section
8	May 17	P/STN	Crude	11	10	1	Jun.11	5L-GR.B 0.375 18"	Instrument'n	8.450	Mech. failure A(b)	Slight soil contamination	Slight contamination of stream	Pump bearing pipe fractured
9	Jun.22	P/L	HFO	15	15	Nil	Jul.31	5L-X42 0.141 4"	Line patrol	4,350	Corrosion C(a)	Nil	Nil	C.P. not fully effective
10	Jun.25	P/L	HFO	12	10	2	Jul. 6	GR. A SCH. 30 0.330 12"	Company personnel	2,650	Corrosion C(a)	Nil	Nil	Corrosion within thermal insulation on pipe exposed to salt-air

REF. NO.	DATE	P/L OR P/STN.	GRADE OF OIL	QUANTITY IN CU.M SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN.	HOW DISCOVERED OR REPORTED	ESTIMATED COST DAM.& REPAIR-£	CAUSE AND CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
11	Jul.23	P/STN	Crude	0.15	0.15	Nil	July 30	16"	Company personnel	3,000	Mech. failure A(b)	Nil	Nil	Leaking gland on buried valve New valve in concrete pit
12	Aug. 7	P/L	HFO	8	8	Nil	Aug. 9	5L-X52 0.219 10"	Excavator driver	5,150	Third party activity E(a)	Slight soil contamination	Nil	Existence of P/L known to plant operator working adjacent to marker post
13	Oct. 2	P/L	HFO	200	198	2	Oct.26	GR. A SCH. 30 0.330 12"	Third party	9,600	Corrosion C(a)	Slight soil contamination	Nil	Section in tiled duct exposed to salt air
14	Nov. 1	P/STN	Gas oil	25	25	Nil	Nov. 2	5L-X52 0.312 24"	Station staff	4,500	Mech. failure A(b)	Nil	Nil	Flange gasket failure Spill confined within P/STN
15	Nov. 1	P/L	HFO	0.5	0.5	Nil	Same day	5LS-X42 0.250 12"	Third party	1,300	Third party activity E(c)	Nil	Nil	Thermal insulation damaged resulting in local external corrosion
16	Nov. 7	P/L	Gas Oil	12	6	6	Same day	5L-GR.B 0.219 6"	Customer staff	50	Mech. failure A(b)	Slight soil contamination	Nil	Gasket failure on ancillary pipework
17	Nov. 18	P/L	Crude	100	60	40	Nov. 20	5L-X52 0.344 28"	Third party	52,300	Nat. Hazard D(a)	Some soil contamination	Drainage ditches only	Pipe overstressed and buckled by land Subsidence
10	Nov.22	P/STN	Crude	4	4	Nil	Nov.24	N.A.	Site night watchman	9,600	Mech. failure A(b)	Slight soil contamination	Nil	Fracture of thermo-well in station pipevork
19	Dec. 5	P/L	Crude	12	0	12	Same day	Unspec. 0.312 8"	Line patrol	1,400	Corrosion C(a)	Slight soil contamination	Nil	Older type pipeline C.P. now installed
20	Dec.29	P/L	HFO	0.4	0.4	Nil	Dec.31	5LS-X42 0.250 12"	Adjacent P/line personnel	2,600	Third Party activity E(c)	Nil	Nil	External corrosion resulting from damage to thermal insulation

Report Nr. 7/75

SPILLAGES FROM OIL INDUSTRY

CROSS-COUNTRY PIPELINES IN WESTERN EUROPE

Statistical Summary of Reported Incidents 1974

A Report by

The Oil Pipelines Special Task Force No. 1

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Stichting C0NCAWE

The Hague July 1975

3.2 Details of Spillage Incidents during 1974

Eighteen separate spillages were reported during 1974. These are detailed in Appendix I and further tabulated in categories and volumetric groups in Appendix II. Fifteen spills related directly to pipelines, and three occurred within pumping-stations.

The three pumping-station incidents all arose from defects in small diameter ancillary piping; in each instance the amount spilled was minimal and wholly contained within the facility.

The 15 pipeline spillages were accounted for by one mechanical failure, eight perforations due to corrosion and six physical ruptures by mechanical equipment operated by "foreign" construction groups.

The mechanical failure arose from fatigue cracking in a bend which had been subjected to abnormal expansion and contraction stress. The volume spilled was not large and was all recovered at site. Five out of six losses due to external corrosion occurred on thermally insulated pipelines carrying heavy fuel oils at elevated temperatures, and all arose from ingress of subsurface water through damaged insulation; the above-ambient temperatures materially assisting the natural corrosion process. In some cases, evidence indicated that physical damage to the outer-sleeve and foamed insulation had probably been inflicted during subsequent adjacent excavations and not revealed to the pipeline operators. Only one "normal" oil pipeline suffered leakage from external corrosion and this was on an older system to which cathodic protection has now been applied. Two incidents were reported due to internal corrosion suffered by lines which had been subjected to abnormal operating procedures, one involving periodic purging with untreated water. Safeguards have been imposed to avoid recurrence and in at least one instance internal surveys have been conducted with specialist equipment to establish potential corrosion areas before full perforation occurs. It must be emphasised that total spillage from all the corrosion defects was negligible, and that all oil was recovered.

Six incidents arose from direct damage due to Third Party activity - five by mechanical earth moving equipment and one by pile-driving plant.

All six cases may be considered as avoidable, inasmuch that excavation or levelling was being carried out either in an unauthorised location, or by unauthorised personnel, or without adequate forewarning to the pipeline operators. Four accidents resulted in major spills, two of which were capable of almost total recovery, but the remaining two occurred in agricultural regions where soil conditions and topography of the area were such that net losses respectively of 405 cubic metres of gasoline, and 668 cubic metres of kerosene were sustained. These two together accounted for over 99.6% of the 1974 net loss of oil. It is recognized that, particularly in the case of gasoline, a considerable volume would have been dispersed by evaporation and in fact all work in the surrounding areas was prohibited for a suitable period to minimise fire risk.

With the exception of the two aforementioned incidents, in 10 of the spillages, all oil spilled was recovered at site, two incidents resulted in net losses considerably less than one cubic metre and in the remaining four incidents the loss was between 1.8 and 4.0 cubic metres.

Four spillage locations were cleared up completely on the day of the occurrence, two the day following, six within one week, and the rest required from 11 days to one month to ensure that no harmful environmental effects remained.

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1974

REF. NO.	DATE	P/L OR P/STN	GRADE OF OIL	QUANTITY IN CU.M SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN.	HOW DISCOVERED OR REPORTED	ESTIMATED COST DAM.& REPAIR-£	CAUSE AND CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
1	Jan. 6	P/L	Heavy Fuel Oil	5	5	Nil	Jan.18	5L-X42 0.250 12"	Third Party	830	Corrosion C(a)	Nil	Nil	Damaged Polythene sleeve and foam insulation allowed ingress of soil water.
2	Jan.28	P/L	Gaso-line	200	198	2	Feb. 2	5L-X52 0.203 8"	Excavator driver	1,670	Third Party activity E(a)	Slight soil contamination	Nil	Excavation by land-owner without adequate line location in advance.
3	Feb.16	P/L	Gaso-line	489	84	405	Feb.20	5L-X42 0.250 10"	Instrument'n	72,00	Third Party activity E(a)	Soil contamination	Nil	Damage by mechanical excavator in agricultural area.
4	Mar. 26	P/L	Heavy Fuel Oil	0.3	all	nil	Same day	5L-GR.B 0.230 6"	Third Party	1,300	Corrosion C(a)	Nil	Nil	Ingress of water through damaged insulation
5	May 19	P/L	Gaso-line	30	26	4	Jun.2O	5L-X52 0.203 8"	Instrument'n	17,000	Third Party activity E(a)	Nil	Nil	Pipe damaged during piling operations for new bridge.
6	May 31	P/STN	Crude	0.5	0.25	0.25	Same day	Instrument Connection	Station Staff	1,000	Mech. failure A(a)	Slight soil contamination	Nil	Disturbance during adjacent construction works caused fracture of connection nipple.
7	Jun. 7	P/L	White oil	O.6	0.5	0.1	Jun.14	0.188 5"	Contractor involved	1,8OO	Third Party activity E(a)	Slight soil contamination	Nil	Damage during excavation of cable trench adjacent to road.
8	Jun. 23	P/L	Heavy Fuel Oil	0.5.	0.5	nil	Jul. 3	5L-X52 0.250 16"	Third Party	1,000	Corrosion C(b)	Slight soil contamination	Nil	Inhibited water now used for ail displacement
9	Jul. 4	P/STN	Gas-oil	2	0.2	1.8	Jul. 5	Instrument Connection	Station Staff	150	Corrosion C(a)	slight soil contamination	Nil	½ⁿ fitting inadequately protected against corrosion.

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1974

REF. N0.	DATE	P/L OR P/STN.	GRADE OF OIL	QUANTITY IN CU.M SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN.	HOW DISCOVERED OR REPORTED	ESTIMATED COST DAM.& REPAIR-£	CAUSE AND CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
10	Aug. 4	P/L	Heavy Fuel Oil	5	5	Nil	Aug. 16	5LS X42 0.250 12"	Third Party	2,000	Corrosion C(a)	Nil	Nil	Water ingress through damaged insulation suspected due to second comer excavation.
11	Aug. 7	P/L	Crude	500	500	Nil	Aug.12	5L-X46 0.250 16"	Contractor involved	25,000	Third Party activity E(a)	Oil spray carried onto adjacent buildings & gardens	Nil	Bulldozer carrying out unauthorized levelling work adjacent to road.
12	Aug.18	P/L	Kero.	668	Nil	668	Aug.19	5L-X42 0.250 10"	Instrument'n	47,000	Third Party activity E(a)	Some soil contamination	Nil	Bulldozer used to level agricultural land.
13	Sep. 9	P/L	Heavy Fuel Oil	0.5	0.5	Nil	Oct.11	5L-GR.B 0.237 4"	Third Party	2,150	Corrosion C(a)	Nil	Nil	Insulation of wrapping damaged.
14	Sep.23	P/STN	Crude	3	1	2	Sep.26	Ancillary connection	Instrument'n	nil	Mech. failure A(a)	Slight soil contamination	Nil	Vibration fatigue fracture of ¾" thermal relief connection.
15	Oct. 7	P/L	Heavy Fuel Oil	1	1	Nil	Same day	5L-X52 0.250 10"	Instrument'n	4,000	Corrosion C(a)	Nil	Nil	Soil water ingress through damaged polyurethane insulation.
16	Nov. 21	P/L	Crude	20	20	Nil	Dec.18	5L-GR.A 0.280 6"	Third Party	17,000	Mech. Failure A(a)	Nil	Nil	Fatigue crack in bend due to thermal expansion and contraction
17	Dec.17	P/L	Crude	1	1	Nil	Same day	0.125 6"	Third Party	2,700	Corrosion C(b)	Nil	Nil	Internal corrosion resulted from accumulation of precipitated water. Section of line replaced
18	Dec.	P/L	Crude	10	10	Nil	Within one Week	0.322 8"	Line patrol	8,000	Corrosion C(a)	Slight soil Contamination	Nil	Number of minute corrosion leaks in an older pipeline (1941) C.P. now installed

spillages from oil industry cross-country pipelines in western europe

statistical summary of reported incidents -1975

A Report by:
The Oil Pipelines Special Task Force No. 1
Prepared by E.M. King and Ph. Rogier

Den Haag
November 1976

3.2 Details of Spillage Incidents in 1975

In all 20 spillages were reported during the year, These are further detailed in Appendix I, and tabulated into categories and volumetric groups in Appendix II. Fourteen incidents related directly to pipelines and six occurred within pumping stations.

Two of the pumping station spills resulted from external corrosion on exposed sections of pipe, one at transition from buried to above-ground location, adjacent to an insulating flange and not under cathodic protection. In both cases the volume spilled was negligible and measurable in litres.
The remaining four station incidents all resulted from operational causes; two by electronic or mechanical default, and two due to the human element. The mechanical failure would not normally have resulted in lost product, but for the coincidental temporary disconnection of a protective alarm system for maintenance purposes. In each case appropriate steps are being taken to prevent recurrence.

The 14 pipeline spillages were accounted for by three mechanical failures, six perforations due to external corrosion, and five physical ruptures caused by mechanical equipment operated by outside contractors near buried pipelines.

Of the three mechanical failures experienced, one arose from a defective insulating joint, one from weld yield on a small diameter test nipple in use during a routine pressure test, and the third from a longitudinal split on a pipe seam weld.

One hundred per cent of all product spilled from the six corrosion leaks was recovered Three of these were only minute weeps resulting in less than a cubic metre being spilled, and only two involved amounts of any magnitude.

All corrosion-related spills involved lines carrying heavy fuel oil, and in two cases ground water had gained ingress through damaged thermal insulation. At least one incidence of damage is suspected to have resulted from undisclosed third-party excavation adjacent to the pipeline involved.

Two of the very small leaks were disclosed subsequent to an internal line survey.

The five accidents caused by third parties involved three impact ruptures by mechanical excavators, one split pipe due to crushing by a tracked vehicle, and one perforation attributable to deep ploughing. In the latter case, it is understood that the pipe was located at between 1 and 1,2 metres of cover, but no information is available on the system of deep ploughing employed. One instance of excavator damage arose where the normal pipe cover of about one metre had been substantially reduced by soil erosion. As may be anticipated, the degree of physical damage inflicted by mechanical plant in two of these cases resulted in comparatively substantial spillages. In one of these almost all oil was recovered due to prompt action by the operator, and in the other gasoline ejected in spray form caused no contamination of the surrounding area, but resulted in total loss of product by evaporation.

In 10 of the 20 incidents last year, all spilled product was recovered from site; three had net losses less than a cubic metre; and six between one and 10 cubic metres. The only irrecoverable loss in excess of 10 cubic metres was the incident that resulted in evaporation of 60 cubic metres of gasoline.

Eleven spill locations were cleaned up on the day of the spillage or the following day; four within a week, and the remaining five in less than a month.

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1975

REF. NO.	DATE	P/L OR P/STN	GRADE	VOLUME- CU. METRES			CLEAN-UP COMPLETED	PIPE SPECN	HOW DISCLOSED	ESTIMATED COST DAMAGE/ REPAIR-£	CAUSE/ CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
				SPILLED	RECOVERED	NET LOSS								
1	Feb. 4	P/STN	HFO	0.2	0.2	NIL	Feb. 5	12 x 0.280" (324 x 7.14 mm) 5L-X52	Operating Personnel	-	Ext. Corrosion C(a)	-	-	Pipe replaced during station pipework alterations
2	Mar. 5	P/L	HFO	0.05	0.05	NIL	Same day	8 x 0.219" (219 x 5.56 mm) 5L-X52	Inspection Survey	4,500	Ext. Corrosion C(a)	-	-	Inspection patrols supplemented by periodic internal surveys
3	Mar.19	P/STN	LFO	0,5	0.1	0.4	Mar. 23	10 x 0.250" (273 x 6.36 mm) 5L-X52	Pressure Monitor	5,000	Ext. Corrosion C(a)	Surrounding pipework sprayed	-	Transition adjacent to insulating joint. Not under C.P.
4	Mar. 20	P/L	GAS	60	NIL	60	Same day	8 x 0.277" (219 x 7 mm) 5L-X52	Pump station instrument-ation.	10,000	Third Party Activity E(a)	-	-	Rupture by excavator replacing protective earthworks after subsidence. Product spray evaporated
5	Apr. 16	P/L	KER	30	20	10	May 15	20 x 0.280" (508 x 7.14 mm) 5L-X52	Pressure test	25,000	Mech. Failure A (b)	Superficial soil Contamination	-	Weld on small pipe nipple split during pressure test
6	Apr. 17	P/STN	GO	4	4	NIL	Apr. 18	-	Control alarm	300	Oper'l Error B(a)	-	-	Closing of vent valve delayed by electronic fault
7	Apr. 25	P/L	HFO	0.1	0.1	NIL	Same day	8 x 0.219" (219 x 5.56 mm)	Inspection Survey	4,500	Ext. Corrosion C(a)	-	-	Periodic internal surveys to be scheduled
8	May 14	P/L	CR	15	9	6	Same day	6" (168 mm)	Third Party Report	1,200	Third Party Activity E(a)	-	-	Excavator operating in agricultural area. Surface reduced by soil erosion
9	May 16	P/L	HFO	3	3	NIL	May 18	12 x 0.250" (324 x 6.35 mm) 5L5-X42	Third Party Report	1,000	Ext. Corrosion C(a)	-	-	Adjacent excavation by suspected third party damaged thermal insulation
10	Jun. 11	P/L	HFO	50	50	NIL	Jun. 20	10 x 0,250" (273 x 6.35 mm) 5L-Gr.B	Control centre instrument-ation	15,000	Ext. Corrosion C(a)	-	-	Water ingress internally damaged insulation. C.P. ineffective in cased crossing

OIL INDUSTRY PIPELINES - DETAILS OF SPILLAGE INCIDENTS - 1975

REF. NO.	DATE P/L OR P/STN	GRADE	VOLUME - CU. METRES SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN	HOW DISCLOSED	ESTIMATED COST DAMAGE/ REPAIR-£	CAUSE/ CATEGORY	DAMAGE	WATER POLLUTION	REMARKS
11	Jul. 10 P/STN	CR	10	8	2	Same day		Station staff	25,000	Oper'l Error B(a)	-	Slight river pollution	Incomplete closure of NRV caused slop tank overflow. Alarm temporarily dis-connected for maintenance
12	Aug. 31 P/L	CR	30	28	2	Sep. 20	34 x 0.312" (864 x 7.92 mm) 5L-X52	Third Party report	122,000	Mech. Failure A(b)	Some soil contamination	-	Longitudinal split on pipe seam weld
13	Sep. 2 P/L	HFO	3	3	NIL	Sep. 4	10 x 0.280" (273 x 7 mm) 5L-X52	Terminal in-strumentation	9,000	Mech. Failure A (b)	Local road surface affected	Slight irrig'n channel contam'n	Defective insulating Joint. Planned replacement for all I.J.'s
14	Sep.9 P/L	CR	5	4-9	0.1	Sep. 23	18 x 0.250" (457 x 6.35 mm) 5L-X52	Pump station instrument'n	270,000	Third Party activity E(a)	Some soil contamination	-	Damage by tracked vehicle during adjacent construction
15	Sep. 23 P/STN	CR	5	5	NIL	Sep. 25	-	Station staff	6,600	Oper'l Error B(b)	Some soil contamination	-	Drain valve left open Mech. indicators to be fitted all station valves
16	Sep. 25 P/L	CR	15	14.7	0.3	Sep. 26	6 x 0.219" (168 x 5.5 mm) 5L-Gr.B	Third Party Report	3,000	Third Party activity E(a)	Soil contamination	-	Pipe damaged by deep ploughing
17	Sep. 27 P/L	HFO	25	25	NIL	Sep. 28	6 x 0.250" (168 x 6.35 mm)	Line patrol	2,000	Ext. Corrosion C(a)	Some soil contamination	-	Water penetration of damaged sleeve and thermal insulation
18	Nov. 4 P/L	CR	120	117	3	Nov. 5	8 x 0.188" (219 x 4.78 mm) 5L-Gr.B	Control centre in-strumentation	14,000	Third Party activity E(a)	-	Slight canal pollution	Ruptured by Excavator Unauthorized adjacent works
79	Nov. 13 P/STN	GO	20	10	10	Nov. 14	8 x 0.203" (219 x 5.16 mm) 5L-X52	Operating personnel	1,600	Oper'l Error B(b)	-	Slight river contam'n	Drain valve left open after pipework alterations
20	Nov. 18 P/L	HFO	0.5	0.5	NIL	Dec. 12	4 x 0.237" (114 x 6.02 mm) 5L.Gr.A	Third Party report	9,300	Ext. Corrosion C(a)	Some soil contamination	-	Older type pipeline. Scheduled for replacement

spillages from oil industry cross-country pipelines in western europe

statistical summary of reported incidents - 1976

A Report by:
The oil Pipelines Special Task Force No. 1
Prepared by E.M. King and Y. Baradat

Den Haag
October 1977

3. GENERAL REPORT

3.1 Volume Transported

The combined length of oil industry pipelines in [illegible] reached a recorded total. of 18,100 kilometres in 1976, that year **transported Sop million,** cubic metres of refined products to the refineries and distribution Europe.

3.2 Details of Spillage Incidents in 1976

Fourteen separate spillage incidents were reported These are detailed in Appendix I and further tabulated categories and volumetric groups in Appendix II. were directly concerned with pipelines and one occurred pump station.

The pump station incident was attributable to a defect in a check valve fitted to small-bore control [illegible]

Four of the pipeline losses were caused by mechanical two by corrosion, two were associated with natural and five resulted from activities by third parties adjacent to the pipelines involved.

Two mechanical failures produced only minute losses of from a defective weld on a repair clamp and the other loosened bonnet bolts on an underground valve, the in a buried valve-pit which became flooded during heavy A third resulted from gasket failure on a remote instrument fitted outside the terminal. The remaining arose from rupture of a longitudinal seam weld which propagated by surge pressure generated when power the sudden stoppage of pumps. Crude oil was discharged agricultural land and a steep ravine channelled a amount into a nearby river. The river was slow-flowing, facilitated containment by floating booms and eventual The large volume not recoverable was accounted for evaporation and the remainder by subsequent soaked vegetation.

One of the two corrosion leaks developed on a insulated fuel oil line, but all product was recovered; occurred in highly aggressive soil conditions where a pipelines entered a common anchor block. A suspect protection system was under investigation at the time. gasoline travelled via a local watercourse into a canal dispersed by evaporation. The apparent high cost of this incident arose from the necessity for temporary multiple lines prior to demolition of the anchor block.

The two spillages attributable to natural hazard each pipe fracture due to landslides, both of which occurred periods of prolonged and abnormally heavy rainfall. In incident an adjacent railway track was also washed pipeline has been diverted away from the danger zone. site has been stabilised by extensive drainage works.

Third party activity was responsible for five of which resulted in large volumes being irrecoverable. arose from execution of abnormal agricultural works prior notice to the operating companies, mainly deep one of which resulted in total loss of product due to from an undisclosed source, but probably attributable tractor concerned in the accident which was itself In a fourth incident a pipeline was perforated by a installing land drains. The pipe at the point of damage 1.2-1.3 metre cover, and a large volume of crude was and widely dispersed through the newly laid network of Although a large amount was recovered by construction and sumps, it was necessary to arrange disposal of the excavation and replacement of about 800 cubic metres of contaminated soil. The pipeline operators were aware of drainage system under construction and had previously the landowner regarding work approaching the vicinity pipe. The final incident involved two oil pipelines in ownerships which were laid parallel to and along the major river. Lateral displacement of this bank into the resulted from an excessive mass of dredged fill being on adjacent land by Port Authority contractors. stability of the original bank was never in doubt, and the displaced section remained whole and intact after subsidence with ornamental trees and line markers still position. The pipelines have now been diverted around affected area.

All oil spilled was recovered from five of the fourteen incidents, two had evaporation losses of less than 2 metres, and two others resulted in net losses of 14 and cubic metres. Of the remaining five, four of which were excess of 100 cubic metres, two were accounted for by incineration, one by total soil replacement, one by of gasoline from exposed water surface, and one where was discharged into a fast-flowing river, by clean-up evaporation and biodegradation spread over a three Four others required clean-up periods in excess of one mainly to extended monitoring of sumps and boreholes to that no further recovery from substrata was possible no harmful effects remained.

3.3 Five-Year Comparison and Trend Analysis

Comparative numbers, volumes and percentages for the period 1972-1976 are set out in Appendices III and IV.

DETAILS OF SPILLAGE INCIDENTS - 1976

REF, NO.	DATE	P/L or P/STN	GRADE	VOLUME - CU. METRES SPILLED	RECOVERED	NET LOSS	CLEAN-UP COMPLETED	PIPE SPECN.	HOW DISCLOSED	ESTIMATED COST DAMAGE/ REPAIR-£	CAUSE/ CATEGORY	DAMAGE	WATER POLLUTION	COMMENTS
1	Jan. 21	PIL	LFO	80 80		NIL	Ja-27	273 x 5.56rnm (10 in x 0.219) 5LX-52	Instrumentation	8,000	Ext. Corrosion C(a)	Slight soil Contamination	-	Corrosion beneath damaged polyurethane insulation
2	Feb 27	P14	Na	negligibin ALL		NIL	Mar. 11	219 x 4.78 mm (8in x 0.188) 5LX-46	Third Party report	11,800	Mechanical failure A(a)	-	Trace on water surface in ditch	Defectives weld on repair clamp
		PIL	Kcr.	158 NIL		156		273 x 6.35 mm (10in x 0.250) 5L-Gr.B						
3	Mar- 13						June		Third Party report	534,000	Third Party activity E(c)	-	River pollution	Marine works by port authority resulted by landslide + collapse of river bank. Lateral pipe diversions carried out.
		PIL	Na	200 NIL		200		356 x 7.92 mm (14 in x 1.312) 5L-Gr.B						
4	Mar- 25	PIL	GO	44 30		14	may s	219 x 5.16 mm (8in x 0.203) 5LX-52	Instrumentation	58,000	Third Party activity E(a)	-	Some Pollution or irrigation channel	Line ruptured by deep ploughing
5	Jun- !3	PIL	GAS	99 NIL		90	June 4	114 x 6.02 mm (4 in x 0.237) 5L-Gr.A	Third Party report	115,000	External Corrosion C(a)	Slight soil Contamination	Water course canal affected	Corrosion at anchor block in peaty Soil. Suspect c.p. under investigation at time.
6	Aug. 3	PIL	HFO	40 38		2	Aug. 7	273 x 5.56 mm (10in x 0.219) 5LX-52	Third Party Report	8,000	Third Party Activity E(a)	Some Soil contamination	-	Line damages by un-notified deep-ploughing operations.
?	Aug. 16	PISTN	Cn	9 9		NIL	Sept. 30	-	Instrumentation	50,000	Mechanical failure A(b)	Slight soil Contamination	-	Defective small-bore Check valve.
8	Aug. 20	PIL	CR	802 196		606	Aug, 24	457 x 8.18 mm (18 in x 0.322) 5LX-52	Third Party report	65,000	Third Party Activity E(a)	Soil Contamination	-	Line ruptured by mole-plough installing land-drains.
9	Sept, 29	PIL	GAS	153 NIL		153	Sept. 30	219 x 5.16 mm (8 in x 0.203) (5LX-52	Instrumentation	147,000	Third Party Activity E(a)	Fire damage to tractor + property	-	Line punctured by Plough
IO	Oct. 18	PIL	LFO	ncghgiblv ALL		NIL	Oct. 19	-	Third Party report	105	Mechanical failure A(a)	-	-	Leaking valve bonnet
I I	Oct. 24	PIL	CR	IjZ2 589		433	Dec. 20	406 x 5.56 mm (16 x 0.219) 5LX-42	Instrumentation	154,000	Mechanical failure A(b)	Soil Contamination	River Pollution	Rupture of longitional seam weld initiated by over-pressure.
12	Nov. 4	PIL	Cn	200 200		NIL	Nov. 25	610 x 7.14 mm (24 in x 0.281) 5LX-52	Instrumentation	161,000	Natural hazard D(a)	Slight Soil Contamination	-	Pipe fracture due to landslip caused bv abnormal rainfall. section diverted.

DETAILS OF SPILLAGE INCIDENTS - 1976

REF. NO.	DATE	PIL OR PISTN	GRADE	VOLUME - CU. METRES SPILLED	RECOVERED	NET LOSS	CLEANUP COMPLETED	PIPE SPECN.	HOW DISCLOSED	ESTIMATED COST DAMAGE/ REPAIR-£	CAUSE/ CATEGORY	DAMAGE	WATER POLLUTION	COMMENTS
13	Nov. 11	PIL	HFO	50	25	25	Nov. 18	273 x 5.14 mm (10 in x 0.203) 5LX-52	instrumentation	96.000	Natural hazard D(a)	Some Soil contamination	-	Landslide due to abnormal rainfall. stabilisation works carried out.
14	Nov. l l	PIL	Na	17	16	1	Mar. 77	-	Third Party Report	18,000	Mechanical failure A(b)	Some Soil contamination wrapping of adjacent lines damaged	-	Defective instrument connection.

report nr. 3/78

performance of oil industry cross-country pipelines in western Europe

statistical summary of reported spillages -1977

A Report by:

The Oil Pipelines Special Task Force No. 1
Prepared by A. de Waal and Y. Baradat

Den Haag
October 1978

3. GENERAL REPORT

3.1 Volume Transported

The combined length of oil industry pipelines in Western Europe reached a recorded total of 18,400 kilometres in 1977, and during that year transported 563 million m3 of crude oil and refined products to the refineries and distribution terminals of Europe (see attached map).

3.2 Details of Spillage Incidents in 1977

Nineteen separate spillage incidents were reported to have occurred during 1977. They are detailed in Appendix I and further tabulated in categories and volumetric groups in Appendix II and as a percentage in Appendix IV, Fourteen spills were directly concerned with pipelines and five occurred at pump stations.

Four of the pipeline losses were caused by mechanical failure. One was due to a crack in a longitudinal weld at the end of a pipe-joint, one was due to a leaking stem seal of a mainline valve, and the other two originated from leaking gaskets of flange connections within a pump station. The gross spillage involved from these spillages amounted to 1 per cent of the total gross spillage.

Two of the reported losses originated from an operational error. Each incident occurred within a pump station where maintenance and manifold modification works had been performed, and in both cases a valve which had been opened to drain affected piping before starting the works was accidentally left open after completion, causing the reported spillages at the moment subject manifolding was taken back into operation. The gross spillage from these incidents amounted to 1 per cent of the total gross spillage.

Three cases of leaks caused by corrosion were reported, In one instance internal corrosion caused by stagnant deposits in a drain line caused spillage within the confines of a pump station. The two other spillages were caused by external corrosion. In one case local corrosion had taken place during the time the cathodic protection impressed current system had been interrupted for the duration of works on a nearby rail-road track. The resulting spillage was very minor. The second case of external corrosion took place at a spot where the corrosion coating had parted from the pipe wall. Ingress of water accumulated and corroded the pipe, the disbonded coating probably reducing effective protection from the impressed current system. The pipeline concerned leads through undulating ground with the leak near the top of a hill. The oil spilled found its way into a small water course which flowed into a nearby river.

Such measures as damming the water course and installation of floating booms and skimming equipment, resulted in 70 per cent of the oil spilled being recovered. The gross spillage from incidents initiated by corrosion amounted to 7 per cent of the total gross spillage.

Three incidents originated from natural hazards.
In one case abnormally heavy rain caused a landslide and the pipeline ruptured at a weld. The outflowing oil was partly recovered and partly disposed off by removing the contaminated soil from the site, leaving no adverse affect on the environment.
In another case exceptional heavy rainfall caused a river to overflow, washing away one of its banks at the location of a pipeline crossing which subsequently broke. Recovery of the oil spilled was seriously hampered by the large area innundated and could only progress effectively after the river had returned to its original course. A new crossing has been installed with a lower elevation than the original pipe. The third case concerned the collapse in a heavy storm of a suspension bridge supporting a pipeline crossing over a river. The pipeline ruptured and out-flowing crude oil was carried by the river to a nearby lake. Rapidly mobilised clean-up crews constructed interceptor dams in the river with built-in culverts to allow passage of uncontaminated Water. A number of in-series floating barriers were installed in the lake at the entrance of the river with skimmers removing oil from the water surface. The river and lake banks were cleaned up by high pressure water spraying combined with the application of absorbents which were subsequently encircled and recovered.
To restore possible depletion of the fish population, the river was restocked with additional species.
The gross spillage from incidents caused by natural hazard amounted to 25 per cent of the total gross spillage.

Seven spillages were caused by third party activity.
In six cases, pipelines were damaged by mechanical equipment: one case of deep ploughing was reported, and five cases of excavators working in the vicinity of pipelines, performing such tasks as installing drainage pipes and cleaning out drainage ditches. In five cases the contractor causing the damage was aware of the existence of the pipeline, but misjudged its exact location or its depth of burial. In five cases the pipeline operating company was not aware of the third party activity.
The total volume of oil spilled in these six cases was some 706 m^3, of which half was recovered in fluid form and half was disposed off partly by taking the contaminated soil away from the site and partly by local incineration. The net loss was practically zero.
One more case was reported, but here almost the total quantity of product spilled was lost to the environment (2,500 m^3 out of 2,530 m3 gross spillage). The incident involved the rupture of the pipe crossing a large river. Third parties had for some time been extracting large quantities of gravel from the river bed for various purposes, and this is thought to have caused a change in level of the river bed and possibly a change of the current flow at the location of the pipeline crossing.

At a time of prolonged heavy rainfall the river was flowing very fast and erosion of the river bed exposed the pipe, causing it to span and rupture. The light product was moved away by the fast running water and dispersed by evaporation. A new river crossing was installed with adequate precautions to prevent recurrence of similar incidents in future. The gross spillage from incidents caused by third party activity amounted to 66 per cent of the total gross spillage.

All oil spilled was recovered from 13 of the 19 incidents. In four cases over 10 m^3 was spilled of which two were in excess of 100 m^3. Soil contamination was treated either by local incineration or by removal of affected soil from the site. Where water courses were polluted, clean-up measures included steps such as bringing in species to restore local fish population. In no case did permanent damage to the environment appear to have taken place.

3.3 Five-Year Comparison and Trend Analysis

Comparative numbers, volumes and percentages for the period 1.973-1977 are sent out in Appendices III and IV.

Compared with the year 1976, the average gross spillage per incident increased slightly from 226 m^3 to 259 m^3; the average net loss per incident increased by a higher percentage from 120 m^3 to 164 m^3, which was mainly due to the one large spill resulting from rupture of a pipeline crossing a large river. The comparable five year figures are respectively 127 m^3 and 67 m^3.

In terms of number of incidents (19), the fairly consistent average of the past five years persisted for 1977, Comparing the different causes and their resulting spillages, it can be seen that the numbers of incidents caused by mechanical, failure, corrosion and natural hazard vary considerably (24, 33 and 7 per cent respectively), while the individual contribution of the total gross volume spilled appear to be of the same magnitude (13 to 14 per cent).

The number of incidents caused by operational error amounted to 7 per cent, resulting in 1 per cent of the total gross spillage.

The number of incidents caused by corrosion reduced over the last two years to 14 - 16 per cent of the total number of incidents compared with 40 - 50 per cent encountered over the preceding three years.

The number of third party induced incidents remained fairly constant over the years and accounted for one-third out of all incidents. Related gross spillage, however, increased slightly approaching two-thirds of the total gross spillage.

DETAILS OF SPILLAGE INCIDENTS - 1977

Ref. No.	Date	P/L or P/STN	Grade	Volumes (c. metres) Spilled	recov. ered	net loss	clean-up comple-ted	Pipe specification	How disclosed	Estimated cost of damage/ repair (£)	Cause/ Category	Damage	Water pollution	Comments		
1	Jan. 11	PIL	CR	600	575	25	end Feb.	610x 11.91mm (24 x 0.469 in) 5LX52	Instru-mentation	2,600,000*	Natural Hazard D (c)	Banks of river and lake (partly) polluted	River and lake (partly) affected	Collapse in heavy storm of pipe-supporting bridge structure		
2	Feb. 3	PISTN	CR	1	1	nil	Feb. 20	-	Station personnel	8,000	Operational error B (b)	Slight soil contamination	Trace on surface in ditch of surrounding fields	Drain valve left open after maintenance works		
3	Mar. 5	PIL	LFO	2	2	nil	Mar. 6	508 x 7.8 mm (20 x 0.307 in) 5LX52	Third party	11,000	Mechanical failure A (b)	Slight soil contamination	-	Crack in longitudinal pipe weld		
4	Apr. 9	P/STN	LFO	28	28	nil	Apr. 9	-	Third party	3,000	Mechanical failure A (b)	Slight soil contamination within station	-	Leaking gasket in sampling line		
5	May 6	PIL	Na	2530	30	2500	Jul. 13	508 x 11.91 mm (20 x 0.469 in) 5LX60	Instrumen-tation	650,000	Third party activity E (c)	Banks of river contaminated	River affected	Erosion of riverbed at p/l crossing due to gravel extraction in vicinity		
6	Jun. 3	PIL	GO	269	269	nil	Jun. 4	219 x 6.35 mm (8 x 0.250 in) 5LX42	Third party	11,000	Third party activity E (a)	Soil contamination	-	Line damaged by excavator doing ground works		
7	Jun. 13	PIL	LFO	I	I	nil	Jun. 17	324 x 6.35 mm (12 x 0.250 in) 5LX42	Instrumen-tation	5,000	Corrosion C (a)	-	-	Cathodic Protection system temporary disconnected during works on nearby railroad		
8	Jul. 28	PIL	GO	191	191	nil	Jul. 29	324 x 6.35 mm (12 x 0.250 in) 5LX42	Instrument-tation	11,000	Third party activity E (a)	Slight soil pollution	-	Line damaged by excavator doing ground works		
9	Aug. 6	PISTN	LFO	32	32	nil	Aug. 6	-	Station personnel	1,000	Mechanical failure A (b)	Slight soil contamination within station	-	Leaking gasket in pressure relief valve		
10	Sept. 17	PIL	CR	80	80	nil	Oct. 6	457 x 5 mm (18 x 0.197 in) St. 47.7	Instrumen-tation	30,000	Third party activity E (a)	Slight soil contamination	-	Line damaged by plough installing land-drains		

* Includes a temporary new crossing

DETAILS OF SPILLAGE INCIDENTS - 1977

Ref. No.	Date	P/L or P/STN	Grade	Volumes (c. metres) spilled	recov-ered	net loss	clean-up comple-ted	Pipe specification	How disclosed	Estimated cost of damage/ repair (£)	Cause/ Category	Damage	Water pollution	Comments
11	Oct. 9	P/L	CR	550	50	500	Oct. 11	508 x 11.2 mm (20 x 0.44 in) 5LX52	Company staff	135,000	Natural hazard D (b)	Agricultural land contaminated	River affected	Heavy rain made river over flow and washing bank away at p/l crossing
12	Nov. 11l	P/L	GO	103	103	nil	Nov. 15	324 x 6.35 mm (12 x 0.250 in) 5LX42	Third party	3,000	Natural hazard D (a)	Soil contamination	-	Line ruptured due to land slide
13	Nov. 15	P/L	GO	3	-	3	Nov. 16	219 x 6.3 mm (8 x 0.250 in) 5LX52	Instrumen-tation	6,000	Third party activity E (a)	Slight soil contamination	-	Line damaged by a farmer's plough
14	Nov. t7	P/L	CR	negligible	all	nil	Nov. 18	914 x 10.3 mm (36 x 0.406 in) 5LX52	Company staff	1,000	Mechanical failure A (b)	Slight soil contamination	-	Leaking stem seal of mainline blockvalve
15	Nov. 22	P/STN	LFO	6	6	nil	Nov. 23	-	Station personnel	-	Corrosion C (b)	-	-	Corrosion of drain line by stagnant deposits
16	Nov. 29	P/STN	CR	50	50	nil	Dec. 2	-	Instrumen-tation	18,000	Operationel error B (b)	Soil contamination within station	-	Relief valve left open after manifold alterations
17	Dec. 9	P/L	CR	160	160	nil	Dec. 16	273 x 6.3 mm (10 x 0.250 in) 5LX42	Instrumen-tation	17,000	Third party activity E (a)	Soil contamination damage to road	-	Line damaged by excavator during drainage works
18	Dec. 23	P/L	GAS	3	2	1	Dec. 24	219 x 4.78 mm (8 x 0.188 in) 5 LX52	Instrumen-tation	9,000	Third party activity E (a)	Slight soil contamination	-	Line flattened and ruptured by excavator cleaning drainage ditch
19	Dec. 28	P/L	GO	315	225	90	In hand	273 x 6.3 mm (10 x 0.250 in) 5LX52	Instrumen-tation		Corrosion C (a)	Soil contamination	River affected	Disbonded wrapping prevented c.p. system from being fully effective

performance of

oil industry cross-country pipelines in western Europe

statistical summary

of reported spillages -1978

A Report by:

The Oil Pipelines Special Task Force No. 1

Prepared by A. de Waal and Y. Baradat

Den Haag `
September 1979

3. GENERAL REPORT

3.1 Volume Transported

The combined length'of oil industry pipelines in Western Europe reached a recorded total of 18,500 kilometres in 1978, and during that year transported 594 million m^3 of crude oil and refined products to the refineries and distribution terminals of Europe (see attached map).

3.2 Details of Spillage Incidents in 1978

Fifteen separate spillage incidents were reported to have occurred during 1978. They are detailed in Appendix I and further tabulated in categories and volumetric groups in Appendix II and as a percentage in Appendix IV. All spills were directly concerned with pipelines and none occurred at pump-stations.

Three of the pipeline losses were caused by mechanical failure. On one occasion the bonnet bolts of a check valve failed under service due to faulty material. The other two incidents originated from faulty pipe which were subsequently replaced: in one incident a 12 cm long crack developed due to a manufacturing fault in the pipe material; the other failure occurred in the longitudinal weld of a pipe joint which cracked and opened up over a length of 200 cm. The resulting spillage of the fuel oil being transported was substantial (2000 m^3) and part of it was taken away by a small stream leading to a pond (approximately 100 m^3). Due to the local geographical situation the remainder was confined in an (agricultural) area with a high groundwater table which made it possible to recover large quantities of oil by digging drainage canals through the area and skimming off the water surface. To date some 1700 m^3 have been recovered and this operation will still continue for some time. The gross spillage involved from mechanical failure amounted to 62 per cent of the total gross spillage.

Seven cases of leaks caused by corrosion were reported. In all cases the corrosion was of an external nature. In one instance corrosion took place at the interface where a pipeline emerged from the ground to continue above ground. On another occasion a total of 3 leaks developed close to each other in a products line, due to galvanic corrosion in an area where the coating was found damaged in places. The remaining 5 incidents concerned insulated pipelines where corrosion took place underneath the polyurethane insulation. Of these, two cased crossings were involved, one under a road and the other over a river. A further two cases of corrosion took place inside manifold pits which were waterflooded from time to time.

DETAILS OF SPILLAGE INCIDENTS-1978

Ref. No.	P/L of P/STN	Grade	Volumes (c. metres)			Clean up period	Pipe specification	How disclosed	Estimated cost of damage/ repair ($)	Cause/ category	Damage	Water pollution	Comments	
			Spilled	Recov-ered	Net loss									
1	PL	HFO	80	40	40	3 days	219x5.56 mm (8x0.219 in) 5LX52	Instru-mentation	2 900	Corrosion C(a)	Soil contamination	-	External corrosion due to defective coating	
2	PL	HFO	120	60	60	5 days	219x5.56 mm (8x0.219 in) 5LX52	Instru-mentation	5 800	Corrosion C(a)	Soil contamination	river affected	External corrosion due to defective coating	
3	PL	LFE3	2	2	0	7 days	324x7.1 mm (12x0.281 in) 5LX52	Third party	12 000	Corrosions G(a)	Slight soil contamination i	-	External corrosion of cased road crossing	
4	PL	KER	12	6	6	29 days	168x5.56 mm (6x0.219 in) 5LGr.B	Third party	5 700	Corrosion C (a)	Sail contamination	-	External corrosion at point where coating was da-maged	
5	PL	CFI	400	150	250	6 month	406x8.74 mm (16x0.344 in) 5LX52	Company staff	155 000	Natural hazard D (a)	Soil contamination	river affected	Heavy rainfall underwashed pipeline which failed in bending	
6	PL	LFO	58	18	40	2 days	324x6.35 mm (12x0.250 in) 5LX52	Instru-mentation	22 000	Third party E (a)	Soil pollution	-	Line damaged by excavator during construction of another pipe was repaired but later failed under pres-sure test	
7	PL	CR	1	1	0	2 days	609.6x6.35 mm (24x0.250 in) Gr.B	Third party	7 500	Third party E(al	Slight soil contamination	-	Excavator damaged a vent line on valve installation	
8	PL	LFO	2.5	2.4	0.1	4 days	273x5.56 mm (10 3/4x0.219 in)	Third party	12 000	Third party E (a)	Slight soil contamination	-	Line damaged by excavator during installation of a sewer system	

DETAILS OF SPILLAGE INCIDENTS-1978

Ref. No.	P/L or P/STN	Grade	Volumes (c.metres) Spilled	recov-ered	net loss	clean up period	pipe specification	How disclosed	Estimated cost of damage/ repair ($)	Cause/ category	Damage	Water pollution	Comments	
9	PL	HFO	4	3	1	1 day	457x6.35 mm (18x0.250 in)	Third party	1 700	Corrosion C(a)	Slight soil contamination	-	External corrosion in main line due to defective coating	
10	PL	GO	100	90	10	38 days	273x6.3 mm (10x0.250 in) LX52	Instru-mentation	49 000	Corrosion C(a)	Soil contamination	Water course affected	External corrosion in river overcrossing cased pipe	
11	PL	FO	2	2	0	2 days	324x6.35 mm (12x0.250 in) X42	Company staff	2 500	Corrosion C(a)	Slight soil contamination	_	Crack in weld of patch over external corrosion defect	
12	PL	CR	255	10	245	5 days	406x7.92 mm (16x0.312 in) 5LX42	Station personnel	20 000	Third party E(a)	Soil pollution	_	Line damaged by excavator working on land cultivation	
13	PL	GAS	235	30	205	1 day	219.1x5.9 mm (8x0.219 in) 5LX52	Instru-mentation	4 000	Mechanical failure A(b)	_	_	Failure of bonnet bolts of check valve	
14	PL	CR	2 000	1 700	300	in hand	864x7.92 mm (34x0.312 in) 5LX52	Third party + company staff	59 000	Mechanical failure A(b)	Soil contamination	Canal and ponds affected	Crack in longitu-dinal weld	
15	PL	CR	19	19	0	10 days	559x6.35 mm (22x0.250 in) 5LX-X60	Third party	88 000	Mechanical failure A(b)	Slight soil contamination	_	Lamination in pipe material	
p.m.	PL	GO	349	129	220					Corrosion C(a)		_	Additional volumes in respect of a leak incident reported over 1977	

performance of oil industry cross-country pipelines in western europe

statistical summary of reported spillages-1979

Prepared by CONCAWE's Special Task Force

on Oil Pipelines Spillages

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October 1980

3. 1979 REPORT

3.1 VOLUME TRANSPORTED

The combined length..of oil industry pipelines in Western Europe reached a recorded total of 19,000 kilometres in 1979 and during that year transported 647 million m^3 of crude oil and refined products to the refineries and distribution terminals of Europe (see figs. 1-7) .

3.2 DETAILS OF SPILLAGE INCIDENTS

Ten separate spillage incidents were reported to have occurred during 1979. They are detailed in Table 1 and further tabulated by category and volume in Table 2.

For the sake of consistency with previous reports, causes have been categorised as follows:

A. Mechanical Failure
   - (a) Construction Fault
   - (b) Materials Fault

B. Operational Error
   - (a) System Malfunction
   - (b) Human error

C. Corrosion
   - (a) External
   - (b) Internal

D. Natural Hazard
   - (a) Landslide or Subsidence
   - (b) Flooding
   - (c) Other

E. Third Party Activity
   - (a) Direct Damage - Accidental
   - (b) Direct Damage - Malicious
   - (c) Incidental Damage

Table 1 Details of Spillage Incidents – 1979

Ref. No.	Pipe-line or Pump Stn.	Grade	Volumes (Cubic Metres) Spilled	Recov-ered	Net Loss	Clean-up Period	Pipe Specification	How disclosed	Estimated cost of damage/ repair (£)	Cause/ Category	Damage	Water Pollution	Comments
1	P/L	Crude	100	99	1	3 1/2 month	(610x6.35 mm) (24x0.25")	Third party	170,000	Mechanical failure A(a)	Soil conta-mination	No	Initial construction damage
2	P/L	Heavy Fuel Oil	5	5	_	1 month	(457x7.9 mm) (18x0.312")	Company staff	5,300	Corrosion C(a)	Soil conta-mination	No	Unfavourable corrosive environ-ment resulting in localized pitting
3	P/L	Crude	100	60	40	12 days	(559x6.35 mm) (22x0.25") 5LX-X60	Instru-mentation	74,000	Mechanical failure A(a)	Soil conta-mination	Irrigation ditch affected	Initial construction damage
4	P/L	Gaso-line	245	95	150	1 day	(203.2x6.4 mm) (8x0.25") 5LX-42	Company staff and third party	not known	Third party activity E(a)	Soil conta-mination	No	Damage caused by ploughing
5	P/L	Heavy Fuel Oil	20	20	_	1 month	(457x7 mm) (18x0.275") API 5L	Company staff	21,000	Corrosion C(a)	Soil conta-mination	Small lake affected	Corrosion underneath insulation due to ingress of water
6	P/L	Heavy Fuel Oil	50	50	_	1 month	(219x5.1 mm) (8.6x0.21") 5LX-X52	Third party	57,000	Corrosion C(a)	Slight soil contamina-tion	Slight water pollution	Corrosion underneath insulation due to ingress of water
7	P/L	Kero-sine	90	40	50	1 day	(304.8x9.52mm) (12x0.375")	Third party	not known	Third party E(a)	Soil conta-mination	No	Damage caused by ploughing
8	P/L	Gas Oil	300	100	200	3 days	(304.8x9.52mm) (12x0.375") 5LX-42	Instru-mentation	not known	Corrosion C(a)	Soil conta-mination	No	External corrosion due to defective coating
9	P/L	Crude	50	49	1	12 days	(457x6.35 mm) (18x0.25") 5LX-X52	Third party	85,000	Third party E(a)	Soil conta-mination	River affected	Line damaged by excavator.
10	P/L	Crude sine	950	570	380	in pro-gress	(273x7.8 mm) 10.75x0.30") 5LX-42	Instru-mentation	276,000	Third party E(b)	Soil conta-mination	Water course affected	Spillage caused by an attempt to make an illegal tap-off

Table 2 Analysis of 1979 Incidents

	Main Category	No. of Incidents		Spillage in Cubic Metres (m^3)			Average Volume per Incident	
		P/L	P/STN	Gross	Recovered	Net	Gross	Net
	Mechanical failure	2	-	200	159	41	100	21
	Operational error	-	-	-	-	-	-	-
	Corrosion	4	-	375	175	200	94	50
	Natural hazard	-	-	-	-	-	-	-
	Third-party activity	4	-	1335	754	581	334	145
	TOTAL	10	-	1910	1088	822	191	82

Resultant net losses

- All spillage recovered 3 incidents
- Up to 1 m^3 net loss 2 "
- 1 - 10 m3 " " – "
- 10 - 100 m^3 " " 2 "
- Over 100 m^3 " " 3 "

Clean-up completion

- Same day - incidents
- Following day 2 "
- Within one week 1 "
- Within one month 5 "
- Longer than one month 2 "

All spills in 1979 were directly concerned with pipelines, and none occurred at pump stations.

Two of the pipeline loss incidents were caused by mechanical failure. The first incident involved a pipeline fracture caused by a crack which developed in the centre of a 30 cm long gouge; the second incident was due to failure of a field bend also caused by a crack. In both cases damage to the pipe appeared to have occurred during the initial construction activities. Oil recovery and disposal were effected by digging drainage ditches to storage pits and subsequent removal of the oil from the pits by trucks. In one incident a channel was dug surrounding the location of the incident to a depth greater than the local water table to prevent the oil from penetrating the unaffected area. The gross spillage from mechanical failure amounted to 10 per cent of the total gross spillage.

Four cases of leaks caused by corrosion were reported and in all four incidents the corrosion was of an external nature. Three leaks occurred in two insulated pipelines transporting bunker Fuel. These latter two lines were installed above ground and corrosion occurred beneath the polyurethane insulation due to ingress of moisture (there was no anti-corrosion coating beneath the insulation). The fourth incident concerned a buried line carrying gasoil. Two lines were repaired by replacing the corroded pipe; the line affected by two incidents is a short bunker fuel line on which remedial action has still to be taken. The gross spillage from these corrosion incidents amounted to 20 per cent of the total gross spillage.

Four incidents originated from third party activity. In three cases a pipeline was damaged by equipment involved in ploughing or trenching of the land. The fourth incident was caused by an attempt by outsiders to install an illegal tap-off point on a product line. The hot-tapping machinery employed was, however, not designed for high pressure and this resulted in a progressive spill. The source of the spill was difficult to locate as it was situated at a location with many incoming and outgoing lines. This resulted in a sizeable spill (950 m^3) of which some two-thirds was either disposed or recovered. The gross spillage from incidents caused by third party activity amounted to 70 per cent of the total gross spillage.

All oil spilled was recovered from 4 of the 10 incidents. Of five cases in which over 10 m^5 was spilled, three were greater than 100 m^3. Soil contamination was treated either by local incineration or by removal of affected soil from the site, and in no case is permanent damage to the environment expected.

performance of oil industry cross-country pipelines in western Europe

statistical summary of reported spillages-1980

Prepared by CONCAWE's Special Task Force
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3. PIPELINE PERFORMANCE

3.1 GENERAL DATA

During 1980. the total length of oil industry cross-country pipelines in Western Europe was reported by the companies to be 19,000 kilometres. The network consisted of a few hundred separate pipelines operated by about seventy companies. In total 636 x 10^0 m^3 of crude oil and refined products were transported through this system in 1980. No pipelines were closed down for the entire year.

The maps included at the end of this report indicate the layout of the oil industry pipelines operated by the companies. (Figs. 3-9).

3.2 DETAILS OF SPILLAGE INCIDENTS

Ten separate incidents were reported in which oil occurred. For the sake of consistency with previous causes have been categorised as shown in the footnote to and further tabulated by category and volume in Table 2. 6385 m^3 of oil was spilled and the combined cost of repair and clean-up was reported as approximately £2.2 million.

All oil spilled was recovered from six of the incidents combined loss to the environment was 548 m^3. In one case clean-up is long-term (i.e. greater than six months). water sources became contaminated as a result of one Two of the incidents concerned pipework within pumping or terminals.

No human injuries, fires or explosions resulted from the incidents in 1980.

Resultant net losses

All spillage recovered	6 incidents
Less than 1 m3 net loss	1 „
1-10 m^3 net loss	- „
10-100 m^3 net loss	1 „
Over 100 m^3 net loss	2 "

Clean-up completion

Same day	- incidents
Following day	3 "
Within one week	2 "
Within one month	2 "
Longer than one month	3 "

Table 1 Details of spillage incidents -1980

Ref. no.	Pipe-line or pump stn.	Grade	Volumes (cubic metres) Spilled	Recov-ered	Net loss	Clean-up period	Pipe specification mm (inches in brackets)	How disclosed	Estimated cost of damage/ repair (£)	Cause/ category	Damage	Water pollution	Comments
1	P/L	Multi-product	762	627	135	3 months	Variable 8.74-5.56 5L - X52	Opera-tional checks	10,500	Third party E (a)	Soil contami-nation	River affected	Pipeline damage by ploughing
2	P/L	Hot fuel oil	111	99	12	20 days	324 x 6.35 (12" x 0.250) 5L - X52	Third party	162,400	Natural hazard D (a)	Soil contami-nation	Yes	Subsidence at concrete support followed by abra-sion/corrosion
3	P/STN	Crude	30	30	-	5 days		Third party	38,000	Third party E (b)	Soil contami-nation	No	Vandals opened 2" valve. Sump tank overflowed
4	P/L	Heavy fuel oil	10	10	–	21 days	273 x 4.78 (10" x 0.188) 5L - X42	Air-borne survei-llance	4,600	Corrosion C (a)	Slight traces of oil conta-mination	No	Local pitting due to decom-posed wrapping
5	P/L	Heavy fuel oil	80	80	–	1 month	273 x 4.78 (10" x 0.188)	Third party	74,000	Corrosion C (a)	Traces of soil con-tamination	No	Local pitting due to decom-posed wrapping
6	P/L	Heavy fuel oil	1.2	1.2	–	3 days	168 x 4.78 (6" x 0.188) 5L Grade B	Company staff	5,600	Corrosion C (a)	Small area of sea shore	Not stated	General corro-sion due to de-composed wrap-ping
7	P/L	Crude	4800	4400	400	> 6 months	1032 x 8.74 (40"x0.344) 5L-X60	Pipe-line opera-tor	1,890,000	Mechanical A (b)	Soil con-tamination 1 hectare	Water course affected	Roof effect fatigue failure
8	P/STN	Multi pro-ducts	7.5	7.0	0.5	2 days	324 x 6.35 (12" x 0.25) 5L - X52 & 60	Pipe-line opera-tor	2,200	Mechanical A (b)	Soil contami-nation	No	Gasket failure resulting from incorrect valve installation
9	P/L	Jet fuel	313	313	-	1 day	(8" x 0.25)	Pipe-line opera-tor	1,800	Third pary E (a)	Not stated	No	Damage caused by equipment used In road construction
10	P/L	Jet fuel	270	270	-	1 day	(12" x 0.28)	Third party	1,800	Third party E (a)	Not stated	No	Damage caused by boring operation

Cause / category:
A - Mechanical failure (a) Construction fault (b) Materials fault
B - Operational error (a) System malfunction (b) Human error
C - Corrosion (a) External (b) Internal
D - Natural hazard (a) Landslide or subsidence (b) Flooding (c) Other
E - Third party activity (a) Direct damage - accidental (b) Direct damage - malicious (c) Incidental damage

Table 2 Analysis of 1980 incidents

	No. of incidents	Spillage in cubic metres (m^3)			Average volume per incident
Main Pump category	Pipeline stab	bri	Gross	Recovered	Net Gross Nett
Mechanical failure	4	8	4	4	07 2404 200
Operational error	-	-	-	-	- - -- -- -
Corrosion	3	1	9	1	30 -
Natural hazard	1	1	1	1	12 911 12
Third-party activity	1	3	7	5	135 310 34
Total	8	2			6385 5637 548 639 55

3.3 CAUSES

3.3.1 Mechanical Failure

Two incidents were attributable to mechanical failure and resulted in a total spillage of 4808 m^3. This volume 75 percent of the total reported oil spilled in 1980 and mainly caused by one event. In this incident fatigue the longitudinal weld in a section of pipe displaying a effect resulted in fracture of the pipeline. The leakage occurred in rural surroundings was first detected by the operator.

The second incident in this category was due to a gasket resulting from incorrect installation of a valve within station. Again the leakage was detected by the pipeline operator.

3.3.2 Operational Failure

No spillages occurred in this category during 1980.

3.3.3 Corrosion

Three spillages resulted from external corrosion defects and a total of 91 m^3 of oil was spilled representing less than 1.5 percent of the overall gross volume for 1980.

All three incidents occurred on thermally insulated fuel oil

pipelines. In each case breakdown of the outer wrapping allowed water ingress to the pipe insulation resulting in local
Two of these incidents accounted for almost all of the in this category and both occurred on the same pipeline.
In each case it would appear that the affected pipelines were fitted with impressed current systems.

There were no reports in 1980 of pipeline failures due internal corrosion defects.

3.3.4 Natural Hazards

One incident in this category was reported in 1980. Movement of the ground caused cracking of a concrete support block. damage was increased as a result of longitudinal pipe due to heating, leading to abrasion of the coating exposure of the bare metal. The pipe was gradually combination of corrosion and friction.

3.3.5 Third Party Activities

There were four reported spillages caused by third parties resulting in a total of 1375 m^3 of oil being spilled. is equivalent to 22 percent of the overall gross 1980.
Three incidents were the result of non-deliberate action, one orginating from damage caused by road construction one from ploughing and one as a result of boring all these incidents the location of the pipeline was the equipment operator was aware of the pipeline. In all the equipment was neither engaged on work for the company nor had the pipeline company been made aware of activity.
The companies operating all three pipelines carried out routine right of way surveillance varying in frequency from once each month.
Action by vandals caused the remaining spillage in this category.
A two inch valve had been opened which resulted in a overflowing. The pipeline company was advised of the a third party.

4. FIVE YEAR COMPARISON AND TREND ANALYSIS

Comparative numbers, volumes and percentages for the period 1976-1980 are given in Tables 3 and 4. These data are graphically in Fig. 1. Fig. 2 shows the relative contribution of each cause category to the total spillages.

Compared with the year 1979, the average gross spillage per incident in 1980 increased from 191 m^3 to 639 m^3 but the average net loss per incident decreased from 82 m^3 to 55 m^3.

In terms of number of incidents, the 1980 figure (ten) is lower than the average over the preceding four years (fourteen fifteen). Comparing the different causes and their spillages, a number of observations can be made.

- The annual number of incidents caused by third party activity has remained fairly constant over the (one-third of all incidents); however, during 1980 category's contribution fell to 22 percent of the gross spillage (versus 70 percent in 1979). Their contribution to the gross volume spilled over the period continues to be considerable (38 percent of total).
- The number of incidents caused by corrosion is of the same magnitude (one-quarter of all incidents), but due nature of this type of defect, their contribution gross volume spilled remains comparatively low (8 of the total).
- The number of incidents caused by mechanical failure remained fairly constant (one-quarter of all however, the contribution to the gross volume half of total) has increased.
- Over the five year period 1976-1980, 10 percent of the incidents were caused by natural hazards, 10 percent of the total gross spillage. In 1980 one incident caused by a natural hazard which two percent gross spillage.
- The contribution of operational errors to the gross volume spilled remained consistently low and amounted to 1 percent (no such incidents occurred in 1976, 79 and 80).
- Of a total sixtyeight spillage incidents recorded during the five year period 1976-1980, 60 percent small volumes of oil and 62 percent of the total spillage was recovered. Of the sixtyeight this period, six caused no environmental Slight pollution of soil and water resulted from fiftyfour

Table 3 Five-year comparison by cause, volume effect 1976-1980

	1976	1977	1978	1979	1980	76-80
COMBINED LENGTH (km x 1000)	18.1	18.4	18.5	19.0	19.0	-
COMBINED THROUGHOUT $m^3 \times 10^6$.	540	563	594	647	636	-
			Number of incidents			
MECHANICAL FAILURE						
Construction	2	-	-	2	-	4
Material	3	4	3	-	2	12
OPERATIONAL ERROR						
System	-	-	-	-	-	-
Human	-	2	-	-	-	2
CORROSION						
External	2	2	7	4	3	18
Internal	-	1	-	-	-	1
NATURAL HAZARD						
Subsidence	2	1	1	-	1	5
Flooding	-	1	-	-	-	1
Other	-	1	-	-	-	1
THIRD PARTY ACTIVITY						
Accidental	4	6	4	3	3	20
Malicious	-	-	-	1	1	2
Incidental	1	1	-	-	-	2
	14	19	15	10	10	68
GROSS SPILLAGE INCIDENTS						
Negligible	2	3	1	--	-	6
1 - 10 m^3	1	4	4	1	3	13
10 - 100 m^3	6	4	5	5	2	22
100 - 1000 m^3	4	7	4	4	4	23
In excess of 1000 m^3	1	1	1	-	1	4
POLLUTION RESULTING						
NONE	1	4	1	-	-	6
SOIL						
Slight	9	13	13	10	9	54
Severe	-	1	1	-	1	3
WATER COURSES						
Slight	4	2	4	1	-	11
Severe	1	3	-	1	2	7
POTABLE WATER	-	-	-	-	1	1

and eleven incidents respectively. Severe soil
tion resulted from incidents. Seven
caused sizeable water requiring extended
to eradicate their effect environment and
incident potable These figures
marked similarity with the previous five-year
analysis (11).

performance of oil industry cross-country pipelines in western Europe

statistical summary of reported spillages-1981

Prepared by CONCAWE's Special Task Force
On Oil Pipelines Spillages

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December 1982

3. PIPELINE PERFORMANCE

3.1 GENERAL DATA

During 1981 the total length of oil industry cross-country pipelines in Western Europe was reported by the respondents to be 18 900 kilometres. The network consists of approximately two hundred separate pipelines. and includes about 100 kilometres of new construction since last year. A combined length of about 500 kilometres was closed down for the entire year. In total 570 million cubic metres of crude oil and refined products were transported through this system.

3.2 DETAILS OF SPILLAGE INCIDENTS

Sixteen separate incidents were reported in which oil spillage occurred. For the sake of consistency with previous reports, causes have been categorised as shown in the footnote to Table 1 overleaf and further tabulated by category and volume in Table 2. In total 1 485 m^3 of oil was spilled and the combined cost of pipeline repair and clean-up was reported as approximately £1 million.

All oil spilled was recovered from 5 of the incidents and the net loss to the environment was 720 m^3. In one case the clean-up was long-term (longer than four months), which was due mainly to bad weather conditions. In no case were potable water sources affected.

No human injuries, fires or explosions resulted from the pipeline incidents in 1981.

Resultant net losses

All spillage recovered	5 incidents
less than 1 m^3	1 "
1 - 10 m^3	5 "
11 -100 m^3	2 "
over 100 m^3	3 "

Clean-up time

One day	2 incidents
Two days up to one week	6 "
Over one week up to one month	6 "
Longer than one month	2 "

Table 1 Details of spillage incidents - 1981

Ref. no.	Pipe-line or pump stn.	Grade	Volume (cubic metres) Spilled	Recov-ered	Net loss	Clean-up time	Pipe specification mm (inches in brackets)	How disclosed	Estimated cost of damage/ repair (£)	Cause/ category	Damage	Water pollution	Comments
1	P/L	Gasoil	600	450	150	7 days	405 x 6.35 (16 x 0.25) 5L Grade B	Company staff	90 000	Mechanical A (b)	Soil contami-nation	Drainage ditch affected	Longitudinal seam failure
2	P/L	Gasoil	10	10	-	2 days	273 x 6.35 (10 x 0.25) 5L Grade B	Third party	9 000	Corrosion C (a)	Soil contami-nation	No	Contact with casing at road crossing
3	P/L	Crude	96	96	-	7 days	141 x 5.56 (5 x 0.219) 5L Grade B	Third parry	27000	Third party E (a)	Soil contami-nation	No	Damage caused by drilling operation
4	P/L	Gasoil	125	80	45	15 days	660 x 9.52 (26 x 0.375) 5L X52	Third party	574 000	Natural hazard D (a)	Soil contami-nation	Stream and sea affected	Crack at weld caused by stress from landslide
5					132	2 days	170 x 3.96 (6 x 0.156) 5L X52	Pipeline operator	3 000	Third parry E (a)	Soil contami-nation	No	Pipeline damaged by bulldozer
6					-	20 days	219 x 5.56 (8 x 0.219) 5L X52	Pressure test	6 200	Corrosion C (a)	None	No	General corrosion in area of weld; failure due to decomposed coating
7					-	10 days	219 x 5.56 (8 x 0.219) 5L X52	Pressure test	18 000	Corrosion C (a)	None	No	General corrosion in area of weld: failure due to decomposed coating
8					2	3 days	323 x 6.35 (12 x 0 25) 5LS X42	Third party	16 000	Corrosion C (a)	Soil contami-nation	No	Faulty wrapping
9	P1L	Crude	10	10	-	14 days	1016 x 15.87 (40 x 0.625) 5L X60	Third party	58 000	Mechanical A (b)	Soil contami-nation	No	Gasket failure
10			s		2	34 days	864 x 12.7 (34 x 0.5) 5L X42	Third party	51 700	Mechanical A (b)	Soil contami-nation	No	Valve gland leakage
11					<0.1	8 days	711 x 7.9 (28 x 0.312) 5L X42	Company staff	7 500	Third Party E (c)	Slight soil contami-nation	No	Heavily laden trucks damage under-ground crudeline at crossing
12				r	10	4 months inter-mittent	610 x 7.9 (24 x 0.311) BS1501-161-26B	Pipeline operator	33 000	Natural hazard D (c)	Soil contami-nation	No	Crack at weld of drain line due to movement caused by frost heave
13					1	1 day	508 x 7.14 (20 x 0.280) 5L X52	Third party	38 000	Corrosion C (a)	Soil contami-nation	No	Wrapped damage caused by rocks under pipeline
14					3	8 days	508 x 7.65 (20 x 0.299) SS 142101	Third party	3 150	Corrosion C (a)	Soil contami-nation	Water course affected	Water penetrated outer wrapping at venting pipe attach-ment
15					58	2 days	324+273x8.74 (12+10x0.344) 5L X42	Pipeline operator	3 800	Corrosion C (a)	Soil contami-nation	No	Decomposed coating
16					317	1 day	219 x 6.35 (8 x 0.25) 5L X42	Pipeline operator	2 200	Third party E (a)	None	No	Damage caused during road repairs

Cause / category A - Mechanical failure B - Operational error C - Corrosion D - Natural hazard E – Third party activity

(a) Construction fault (a) system malfunction (a) External (a) Landslide or subsidence (a) Direct damage - accidental
(b) Materials fault (b) Human error (b) Internal (b) Flooding (b) Direct damage – malicious
(c) Other (c) Incidental damage

Table 2 Analysis of 1981 incidents

		No. of incidents	Spillage in cubic metres (ma)		Average volume per incident	
Main Pump category	Pipeline station	Gross	Recovered	Net	Gross	Net
Mechanical failure		3	620	468	152	207
Operational error		--	--	--	-	_
Corrosion		5	2	155	91	64
Natural hazard		1	1	155	100	55
Third-party activity		4	-	555	106	449
Total		13	3	1485	765	720

					51	
					22	9
					77	28
					139	112
					93	45

3.3 CAUSES

3.3.1 Mechanical Failure

Three incidents caused by mechanical failure resulted in a total gross spillage of 620 mª. This volume representing 42 percent of the gross spillage reported in 1981 was mainly spilled as a result of one event. In that case the pipe split along the longitudinal seam. The leakage occurred in industrial surroundings, and was detected by the pipeline operator.

The two other incidents in this category were caused by a faulty valve gland and by a gasket failure, respectively. They occurred in industrial surroundings, and were detected by third parties.

3.3.2 Operational Failure

No spillages occurred in this category during 1981.

3.3.3 Corrosion

Most of the reported spillages (seven) resulted from corrosion defects; the volume involved, however, amounted to roughly 10 percent of the total oil spilled, namely to 155 mˢ.

All failures were due to external corrosion.

Two incidents occurred within pumpstations on the same line and in each case during pressure tests. Both were caused by corrosion adjacent to the seam weld in spite of the facilities having cathodic protection systems installed. The spilled volume of 24 m^a was completely recovered.

The spillage with the highest loss in this category (92 m^s gross, 58 m^a net) occurred on a cathodically protected pipeline. Neverthe less a corrosive environment caused pittings, which finally resulted in a crack of 55 cm in length. The incident was first discovered by the pipeline operator.

Of the remaining four incidents resulting from corrosion, one was caused by the pipe contacting its protective sleeve at a road crossing, another by ingress of groundwater into the polyurethane insulation surrounding the pipe, and two by faults in the integrity of the wrapping.

3.3.4 Natural Hazards

Two incidents were reported in this category, of which one occurred in a pumpstation. In this case a drain-pipe was lifted by a stone, which itself was moved as a consequence of frost heave. The shifting of the drain-pipe caused a crack at the connection of the drain-pipe and the main line.

The second incident was caused by a landslide, which led to a fracture at a welding ;joint of the pipeline. The incident occurred during refilling temporarily inhibiting the volume balance leak detection system installed.

3.3.5 Third Part Activities

Third party activities caused four incidents. In total 555 m^s out of the J. 485 m^a gross volume spilled - i.e. about 37 percent - resulted from these activities. Two cases with a total of 454 m^s gross and 449 m^a net losses occurred in districts similar to deserts, where the pipes were laid in porous subsoil. Both leaks were discovered directly by the pipeline operators as a consequence of the pressure drop, and the pumps were shut down immediately. The spills however, occurred at unfavourable locations such that a significant proportion of the linefill between two adjacent valves was released.

The equipment operators - road repair workers and farmers - were in both cases aware of the pipeline. The pipeline companies concerned, however, were not informed about any activities in the respective areas. The latter is also true for the third case, in which the pipe was damaged by drilling operations.

In the last case the damage was caused by heavily laden trucks crossing the underground pipeline.

performance of oil industry cross-country pipelines in western europe

statistical summary of reported spillages-1982

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December 1983

3. PIPELINE PERFORMANCE

3.1 GENERAL DATA

The total length of oil industry cross-country pipelines in Western Europe in operation at the end of 1982 was reported by the respondents to be 18,300 kilometres. The network consists of approximately two hundred separate pipelines. New pipelines brought into service accounted for 250 kilometres and a combined length of about 850 kilometres became non-operational during 1982. In total 532 million cubic metres of crude oil and refined products were transported through this system. This resulted in a total traffic volume of 92 x 10^9 m^3 x km, of which products amounted to 12 x 10^9 m3 x km.

3.2 DETAILS OF SPILLAGE INCIDENTS

Ten separate incidents were reported in which oil spillage occurred. For the sake of consistency with previous reports, causes have been categorised as shown in the footnote to Table 1 and further tabulated by category and volume in Table 2. In total 644 m^3 of oil. were spilled and the combined cost of pipeline repair and clean-up was reported as about £ 1 million.

In five of the incidents all oil spilled was recovered and the net loss to the environment was 174 m^3. In two cases the clean-up times were four and five months respectively, and in one of these cases potable water sources were affected.

No human injuries resulted from the pipeline incidents in 1982.

Resultant net losses

All spillage recovered	5 incidents
less than 1 m^3	1 incident
1 - 10 m3	1 incident
11 - 100 m3	2 incidents
over - 100 m3	1 incident

Clean-up time

One day	- incidents
Two days up to one week	2 incidents
Over one week up to one month	6 incidents
Longer than one month	2 incidents

Table 1 Details of spillage incidents - 1982

No.	Pipe-line or pump-stn.	Pipe Specification mm (inches)	Commo dity	Volumes (m^3) spilled	Re-covered	Net loss	How dis-covered	Cause Category	Cause origin	Damage Water pollution river,water course. etc.	Soil contamination (area affected)	Estimated cost/ repair (£)	Clean-up period
1	P/STN	114 x 3.6 (4.5 x 0.142) St 43.7	Crude	20	20	--	Third party	Corrosion C (b)	Internal corrosion at the lowest point of a buried slopline	water course affected	soil contamination	79,000	30 days
2	P/L	254 x 6.35 (10 x 0.25) 5L Grade B	Gasoil	400	384	16	Third party	Corrosion C (a)	General corrosion at an area of varying groundwater level	water course affected	soil contamination	285,000	5 months
3	P/L	203 x 7.04 (8 x 0.277) 5LX-X52	Gas-oline	12	--	12	Third party	Mechanical A (a)	Crack at a dent, resulting from stress cycling	potable water affected	soil contamination	355,000	4 months
4	P/L	660 x 6.35 (26 x 0.25) 5LX-X52	Crude	9	9	--	Third parry	Mechanical A (b)	Material embrittle-ment	no	soil contamination (1 000 m^2)	42,000	3 days
5	P/L	168 x 3.96 (6.75 x 0.156) 5LX-X52	Light crude	140	--	140	Third party	Corrosion C (b)	Internal corrosion	no	soil contamination (3 000 m^2)	17,000	16 days
6	P/L	305 x 6.35 (12 x 0.25) 5LS-X42	Fuel	8	8	--	Third party	Corrosion C (a)	Pitting corrosion due to damaged coating	no	soil contamination (30 m^2)	12,000	< 1 month
7	P/L	203 x 7.04 (8 x 0.277) unknown	Crude	2	2	--	Operator	Corrosion C (a)	Pitting corrosion due to damaged coating	no	soil contamination	26,000	12 days
8	P/L	203 x 5.56 (8 x 0.219) 054D	Gasoil	6.5	6	6.5	Company staff	Third party E (c)	A dent, caused by an excavator stalled a pig, resulting in damage due to pressure transient	no	soil contamination	3,000	13 days
9	P/L	159 x 5.0 (6.25 x 0.197) unknown	Crude	31	31	--	Third party	Third party E (a)	Damage caused by farming activities	no	soil contamination	12,000	3 days
10	P/L	559 x 7.0 (22 x 0.313) 5L Grade B	Crude	15	10	5	Third party	Corrosion C (b)	Internal pitting caused by high salt water content	no	soil contamination	190,000	< 1 month

Cause/category: A - Mechanical failure (a) Construction fault (b) Materials fault; 0 - Operational error (a) System malfunction (b) Human error; C - Corrosion (a) External (b) Internal; D - Natural hazard (a) Landslide or subsidence (b) Flooding (c) Other; E - Third party activity (a) Direct damage - accidental (b) Direct damage - malicious (c) Incidental damage

Table 2 Analysis of 1982 incidents

Main category	Number of incidents Pipeline	Pump-station	Spillage in cubic metres (m^3) Gross	Recovered	Net	Average volume per incident Gross	Net
Mechanical failure	2	-	21	9	12	11	6
Operational error	-	-	-	-	-	-	-
Corrosion	5	1	585	424	161	98	27
Natural hazard	-	-	-	-	-	-	-
Third party activity	2	-	38	37	1	19	1
Total	9	1	644	470	174	64	17

3.3 CAUSES

3.3.1 Mechanical Failure

Two incidents caused-by mechanical failure resulted in a total. gross spillage of 21 m^3, representing 3 percent of the gross spillage in 1982. Both leakages occurred in rural areas and were detected by third parties. The first case was attributable to a construction fault; the bucket of an excavator struck the pipe, and the resulting dent was the starting point of a crack due to stress cycling during several years of operation. In the other case the cause was assessed to be due to embrittlement of the pipe material.

3.3.2 Operational Failure

No spillage occurred in this category during 1982.

3.3.3 Corrosion

Six spillages (or 60 percent) resulted from corrosion defects, causing 585 m^3 (or 91 percent) of the gross volume spilled. Three failures each were attributable to external and internal corrosion.

One incident was caused by internal corrosion of a buried slopline inside a pumping station and was first detected by a third party. The damaged pipe has been replaced and relocated above ground.

Another failure due to internal corrosion occurred in porous ground at a remote location used for grazing. The line was transporting light crude and a shepherd first detected the leak. A sizeable area was contaminated resulting in the loss of some sheep.

The third leak due to internal corrosion occurred in a line transporting crude with a high salt water content. No corrosion inhibitor was used. As a consequence localized pitting of 2 to 3 mm depth occurred in an area where the water could gather. The resulting metal loss finally led to a hole in the pipe wall of 8 mm diameter.

The spillage reporting the highest loss was caused by external corrosion and occurred in a pipeline, which was cathodically protected by an impressed current system. This resulted in 400 m^3 being spilled, representing 62 percent of the 1982 gross loss. The damage took place in a rural area and was discovered by a third party. The corroded part of the pipe was situated within the seasonal range of the groundwater levels, which materially affected local soil conditions.

The remaining two incidents resulting from external corrosion were caused by localised pitting due to failures of the coatings. In one case the line was cathodically protected.

3.3.4 Natural Hazards .

No spillages were reported in this category during 1982.

3.3.5 Third Party Activities

Third party activities caused two incidents - one directly and the other indirectly - Jointly contributing 6 percent to the 1982 gross spillages. In the first case the equipment operator - a farmer - was aware of the pipeline and had also been notified of restrictions in the use of his equipment in the vicinity of the pipeline. The location of the line itself was identified by permanent markers; moreover, the farmer had been provided with a map. The pipeline company, however, was not made aware of any activities in the area concerned.

Regarding the second case, the line failure resulted from a pressure transient created when an internal inspection tool stalled at a dent previously caused by a third party excavation.

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performance of oil industry cross-country pipelines in western Europe

statistical summary of reported spillages -1983

Prepared by CONCAWE's Special Task Force
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3. PIPELINE PERFORMANCE

3.1 GENERAL DATA

The total length of oil industry cross-country pipelines in Western Europe in operation at the end of 1983 was reported by the respondents to be 18,100 km. The network consists of some two hundred separate pipeline systems. New pipelines brought into service accounted for 140 km, another 180 km were reactivated and a combined length of about 500 km became non-operational, during 1983. In total. 505 million m^s of crude oil and refined products were transported through this system. This resulted in a total traffic volume of 88 x 10^9 m^s x km, of which products amounted to 20 x 10^9 m^3 x km.

3.2 DETAILS OF SPILLAGE INCIDENTS

Ten separate incidents were reported in which oil spillage occurred. For the sake of consistency with previous reports, causes have been categorised as shown in the footnote to Table 1 and further tabulated by category and volume in Table 2. In total 1,688 m^3 of oil were spilled and the combined cost of pipeline repair and clean-up was reported to be £140,000.

Total net loss to the environment was 982 m^3. In four of the incidents all oil spilled was recovered. In no cases was the clean-up time longer than one month; no potable water sources were affected.

No human injuries resulted from the pipeline incidents in 1983.

Resultant net losses

All spillage recovered	4 incidents
less than 1 m^3	1 incident
1 - 10 m^3	- incident
11 - 100 m^3	- incident
over - 100 m^3	5 incidents

Clean-up time

One day	2 incidents
Two days up to one week	4 incidents
Over one week up to one month	4 incidents
Longer than one month	– incident

Table 1 Details of spillage incidents - 1983

No.	Pipeline or Pump-stn.	Pipe specification mm (inches)	Commodity	Volumes(m^3) Spilled	Re-covered	Net loss	How discovered	Cause Category	Cause Origin	Damage Water pollution: type	Soil pollution: area affected (m^2)	Estimated total cost (£)	Clean-up period (days)
1	P/L	152 x 4.78 (6 x 0.188) 5LX-42	Gasoil	12	12	-	During pressure test	Corrosion C (a)	External corrosion at a point where an above ground line ran for a short distance underground	no	yes 3600	4700	10
2	P/L	102 x 3.96 (4 x 0.156) 5L FB50	Lube distillates	4	4	-	Third party	Mechanical A (b)	Equipment failure	no	yes 80	3700	1
3	P/L	102 x 3.96 (4 x 0.156) 5L EB50	Lube distillates	1	1	-	Autom. detect. system	Mechanical A (a)	Rupture of a seam by which spillage No. 2 provisionally had been repaired	no	yes 9	3600	1
4	P/L	102 x 3.96 (4 x 0.156) 5L FB50	Lube distillates	10	10	-	Autom. detect. system	Mechanical A (a)	Gland leakage	no	yes 100	13 000	10
5	P/L	168 x 3.96 (6.75x0.156) 5LX-X52	Light crude	148	38	110	Third party	Third party E (a)	Damage caused by road construction activities	water course affected	yes 18 000	8500	2
6	P/L	168 x 3.96 (6.75x0.156) 5LX-X52	Light crude	182	62	120	Pipeline operat.	Corrosion C (b)	Internal corrosion at a small crack resulting from bending during construction	water course affected	yes 20 000	5100	3
7	P/L	305 x 9.52 (12xO.375) 5L-Grade B	Crude	1.4	1.2	0.2	Third party	Third party E (c)	Damage caused by a discharge from the grounding connection of a power plant to the pipeline	no	yes 15	26 800	6
8	P/L	406 x 5.56 (16x0.219) 5LX-X42	Mix of crude/naphtha	442	331	111	Pipel. operator	Oper. error B (b)	Inadvertent closing of a valve	no	yes	28 700	20
9	P/L	356 x 7.5 (14x0.295) 5LX-X52	Gasoil	675	205	470	Third party	Third party E (b)	Blow-up of two valves at a road crossing	no	yes	44 200	30
10	P/L	254 x 6.35 (10 x 0.25) 5LX-X42	Gasoil	213	42	171	Third party	Third party E (a)	Damage caused by road construction activities	no	yes	1600	5

Cause/category: A - Mechanical failure
(a) Construction fault
(b) Materials fault

B - Operational error
(a) System malfunction
(b) Human error

C Corrosion
(a) External
(b) Internal

D Natural hazard
(a) Landslide or subsidence
(b) Flooding
(c) Other

E Third party
(a) Direct damage -accidental
(b) Direct damage - malicious
(c) Incidental damage

Table 2 Analysis of 1983 incidents

Main category	Number of incidents		Spillage in cubic metres (m³)			Average volume per incident	
	Pipeline	Pump-station	Gross	Recovered	Net	Gross	Net
Mechanical failure	3	-	15	15	-	5	-
Operational error	1	-	442	331	111	442	111
Corrosion	2	-	194	74	120	97	60
Natural hazard	-	-	-	-	-	-	-
Third party activity	4	-	1037	286	751	259	188
Total	10	-	1688	706	982	169	98

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Prepared by CONCAWE's Special Task Force on Oil Pipeline Spillages

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2. PIPELINE PERFORMANCE

2.1 GENERAL DATA

The total length of oil industry cross-country pipelines in Western Europe in operation at the end of 1984 was reported by the respondents to be 17,300 km. The network consists of some two hundred separate pipeline systems. New pipelines brought into service accounted for 200 km, and a combined length of about 250 km became non-operational. during 1984; another 750 km were excluded from this report as they are not operated by the oil. industry. In total 495 million m^3 of crude oil and refined products were transported through these systems. This resulted *in a total* traffic volume of 84 x 10 m km, of which products amounted to 20×10^9 m^3 km.

2.2 DETAILS OF SPILLAGE INCIDENTS

Thirteen separate incidents were reported in which oil spillage occurred. For the sake of consistency with previous reports, causes have been categorised as shown in the footnote to Table 1 and further tabulated by category and volume in Table 2. In total, 5198 m^3 of oil were spilled and the combined cost of pipeline repair and clean-up was reported to be £ 2.7 million.

Total net loss to the environment was 4427 m^3. In five of the incidents all oil spilled was recovered. In four cases clean-up time took more than one month; no potable water sources were affected.

No human injuries resulted from the pipeline incidents in 1984.

Resultant net losses

All spillage recovered	5 incidents
less than 1 m^3	1 incident
1 - 10 m^3	3 incidents
11 - 100 m^3	1 incident
over - 100 m^3	3 incidents

Clean-up time

One day	1 incident
Two days up to one week	4 incidents
Over one week up to one month	4 incidents
Longer than one month	4 incidents