Summary and conclusions

Recent USCG PIRS and USGS Event file data have been analyzed for application to the offshore petroleum development environmental impact assessment problem. The primary focus of the analysis was the elucidation of the oil spill as it is portrayed by these data sources. Considerable care was exercised in the validation of the data, with the result that our classification of tanker, platform and pipeline spills is probably the most thorough and accurate to date. We found, for example, that the proper number of spills caused by U.S. tankers in 1973-1975 was on the order of 370, versus the 1000+ indicated by the raw PIRS data. Spill incidence models were developed using objective techniques in those cases where the data was sufficiently complete to allow analysis. These cases included tanker and production platform spills. A Bayesian methodology for determining oil spill volume distributions was developed for uncensored spill volume data. This was applied to two classes of tanker spills with apparent success. The volume distributions for platform and pipeline spills were not determined with the same success mainly because we used the USGS Event file data which is highly censored, including only those spills over 42 gallons (1 BBL).

The effects of wind, current and wave height were investigated using the PIRS data for tankers, platforms and pipelines. The technique used was to compare means and variances of the environmental parameters conditional on the occurrence of a spill, with the unconditional moments.

Although this technique is fairly coarse, we believe that our results show there is no basis in the data for justifying spill incidence models linked to environmental conditions, except for models based on the rare survival-threatening extreme event. A technique for looking at the extreme event problem was presented in our early report (Stewart and Kennedy 1977a).

The effects of age were investigated for tankers and production platforms. Old tankers, tankers built before 1955, were found to have more spills on a unit basis than new tankers. Conversely, production platforms over ten years old had far fewer spills than new production platforms. There is some indication that platforms exhibit this behavior due to run-in problems encountered as new processing and housekeeping equipment are brought into use. Old platforms, for example, had high spill incidence rates in 1971 and 1972 due to the low reliability of the hastily installed housekeeping equipment required by OCS Order No. 8. Our experience in 1973-1975 shows that only a few new platforms encounter problems of this type in any given year. The difference between old and new platforms might also be related to the limited economic life of platforms, although we believe the ten year cutoff is too short to be important under the artificial production rate restrictions that were in effect prior to 1975. These restrictions had the effect of prolonging the platform's economic life.

Table 24 summarizes the various models developed in this report. U.S. tanker spills are classified as either hull-rupture or non-hull-rupture events. Spills from hull ruptures were seen to be less frequent but larger. The frequency-of-occurrence models for both kinds of tanker spill are based on individual ship spillage records over the 1973-1975 period as recorded in the corrected PIRS data. Hull-rupture spills were seen to be distributed as inverse-gamma variates. Non-hull-rupture spills were seen to be lognormally distributed.

Two kinds of production platform spills were identified: blowout and nonblowout. As a general class, the blowout spill was seen to be the largest of the spill types considered, three out of ten being over one million gallons. By comparison, the largest U.S. tanker spill in 1973 to 1975, a period encompassing 370 U.S. tanker spill incidents, was 196,100 gallons. The spill incidence model for the nonblowout platform spills was developed objectively using unit-specific USGS spill records from the Gulf of Mexico. To accommodate the run-in problem, the technique estimates the (small) subset of platforms having run-in difficulties. The remaining platforms are assumed to have spills at a rate equal to that of the old platforms. The incidence model for blowouts includes both operationally encountered blowouts, and those caused by extreme events. The spill volume distribution for nonblowouts is not reliable due to the censoring of the USGS data. The

TABLE 24
SUMMARY OF SPILL MODELS

Spill Source			Spill Incidence Model			Spill Volume Model			Comments
			Distribution Type	Parameters	Basis	Distribution Type	Percentile (Gal) 50%	Percentile (Gal) 99%	
U.S. Tanker	Hull rupture		Poisson	$n=15$, $\tau=235$ / Tanker years	Objective PIRS	Inverse Gamma	85	40,000	Analytic results have good reliability
U.S. Tanker	Other		Poisson	$n=77$, $\tau=235$ / Tanker years	Objective PIRS	Log Normal	23	3,000	Analytic results have good reliability
Production Platform	BLOWOUT	Extreme event	Based on site-specific evaluations of seismic and hurricane risks			Mixture	$8*10^4$	greater than 10^8	Small sample (10 events). Censoring of 8 "minimal" spills probably unimportant.
Production Platform	BLOWOUT	Opera-tional	Poisson	$n=7$, $\tau=4.91x10^4$ / Well years	Subjective USGS				
Production Platform	OTHER	Run-in	No. Plats.Poisson; each plat. has 4 spills	$n=4$, $\tau=1,543$ / New platform yrs	Subjective USGS	Inverse Gamma	160	1,600	Data severely censored. Analytic distribution only approximate.
Production Platform	OTHER	Opera-tional	Poisson	$n=24$, $\tau=1,688$ / Platform years	Objective USGS				
Pipelines			Poisson	$n=76$, $\tau=3,700$ / Mile years	Subjective USGS	Inverse Gamma	170	12,000	Data severely censored. Analytic distribution only approximate.

n = historical number of spills
τ = historical exposure

Note: Percentiles based on Bayesian posterior cumulative distribution.

blowout spill volume distribution is of indeterminate reliability due to the censoring of the eight "minimal" spills in the USGS summary. It could well be the case, however, that these "minimal" spills were drawn from a distribution very much unlike the larger blowouts, and so the censoring could have generated a coherent data set, assisting in this case rather than hurting.

The remaining spill source in Table 24 is pipelines. We didn't have too much to say about those spills for two reasons.

1. The censoring of the USGS data somewhat invalidated our technique for volume distribution analysis.
2. The absence of segment-specific identifiers in the Event file prevented a unit-specific frequency-of-occurrence analysis. Nevertheless, use of the proposed incidence and volume models should represent a step forward over existing techniques.

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