MAINTENANCE RELATED INCIDENTS IN TOPSIDE SYSTEMS

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The Health and Safety Executive, Offshore Safety Division is concerned with influencing the duty holder to identify and reduce the risk to personnel on offshore installations and certain other vessels and pipeline operations. This paper discusses the results of a study aimed at identifying reportable offshore incidents which have occurred during maintenance activities and may be related to maintenance having not been done, or done incorrectly.

The paper will outline the data source used, it's codification, and the method adopted for storage and retrieval. It will discuss the findings, which show that around 15% of incidents occur during maintenance, and a further 30% occur following maintenance. The results of statistical analysis aimed at determining patterns and trends in the data will be shown.

Key Words: Safety, Maintenance, Offshore, Topside Systems, Statistics

The Health and Safety Executive (H.S.E.) has now had overall responsibility for offshore safety since April 1991. As well as having a regulatory role, it carries out a series of research investigations to provide feedback to the oil industry of potential areas where particular operating methods could increase the risk to personnel. The theme of data collection analysis and feedback, is one which underlines the recommendations made within Lord Cullen's inquiry report on the Piper Alpha disaster.

The particular work discussed in today's paper falls within this area of activity and is concerned with the maintenance activity on offshore installations. The aim was to examine from historic data whether or not maintenance could have been a factor involved in reportable safety incidents during a 3 year period of 1989 to 1991 inclusive. In particular the narratives of incident reports were examined to determine whether they were related to maintenance i.e. had occurred during maintenance, occurred subsequent to maintenance, occurred due to incorrect maintenance.

The identification of such patterns would then play an important part in the guidance and policy documents issued by the H.S.E. to improve worker safety on current and future offshore installations.

Figure 1 shows the structure of reporting which occurs following an incident offshore. An initial verbal report is made by the duty holder and for about 80 to 90% of all reported incidents a written OIR9A is completed and returned to H.S.E. Should the requirement be seen for a more detailed investigation then these are carried out by

H.S.E. Inspectors who have laid down criteria for such additional investigations. Information from these incidents are used to:

- instigate follow up action with the company concerned
- improve guidance documentation to the industry
- target future inspections
- aid policy documentation to influence safety.

Other sources of data include duty holders' own reports on incidents which have occurred.

The primary source of data used in the study was the Offshore Installation Report 9A OIR9A which is returned by a duty holder following a reportable incident. Each report returned to the H.S.E. is stored on a database which records all the details of the form including the narrative. Whilst the form has boxes to indicate such factors as the activity, the operation being carried out and the broad classification of the incident type, no attempt had been made to relate the factors to determine possible causes or trends. The purpose of the work reported in this paper was to examine the data for such trends and patterns. To achieve this each narrative over a 3 year period was read and, together with the boxed data indicated, a conclusion can be drawn on whether or not the incident may be related to maintenance activity; albeit maintenance activity not carried out correctly on a previous occasion.

This subjective assessment enabled a more detailed database to be created indicating codes as follows:

- type of operation
- activity leading to incident
- broad incident type
- shortcomings
- environment
- maintenance related

(Supporting data such as date of incident was also included.)
Within each of these headings the codes shown in figure 2 were used to identify different factors.

Each of 1,971 incidents reported during the 3 year period were read and codified, as a result of which it was found that 290 (14.7%) occurred during maintenance and 599 (30.3%) occurred due to a maintenance related factor. This ratio ties in closely with other studies of maintenance related incidents (Ref. 1).

Looking at the data in detail the following information has been extracted related to the particular groupings of incidents.

Figure 3 shows the distribution of data within the database as originally classified by the duty holder (irrespective of any relationship to maintenance). The vertical axis shows the broad incident type, whilst the two ground axes show the activity at the time of the incident and the operation being undertaken. Each box on the graph represents a set of data points which have common groups of codes. In the interest of clarity the individual codes have not been shown in the figure, but are detailed in figure 2.

The main points of interest in figure 3 are:

Box 1

186 incidents may have involved deck operations using plant and machinery specifically hoists, lifts and cranes.

Box 2

76 incidents may have involved drilling/workover operations using plant and machinery specifically hoists, lifts and cranes.

Box 3

68 incidents may be production operations using plant and machinery related to gas leakage.

Box 4

84 incidents may be drilling/workover operations using plant and machinery specifically involving the machinery itself.

Reference 1
A Study of Fatal Accidents at Work Pub. HMSO
ISBN 0 11 883806 7

Figures 4 and 5 show the maintenance categories from the study (Maintenance related - M1, possibly maintenance related - M2, not maintenance related - M3) related to activity and operations.

Again some of the interesting patterns of data are:

(Figure 4 - activity)

Box 1

492 incidents possibly related to maintenance on plant and machinery.

Box 2

60 incidents maintenance related involving using portable tools/equipment.

Box 3

62 incidents maintenance related involving plant and machinery.

(Figure 5 - operations)

Box 1

136 incidents during production possibly related to maintenance.

Box 2

139 incidents during drilling and workovers possibly related to maintenance.

Box 3

173 incidents during dock operations possibly related to maintenance.

Figure 6 shows the relationship of maintenance to the additional coded field of 'shortcomings'. The graph of shortcomings reveals a number of interesting groupings including:

Box 1

182 incidents were possibly related to inadequate precautions (e.g. dress, removal of fuses etc.) (Maintenance related.)

Box 2

40 incidents were possibly related to wrong use of equipment. (Maintenance related.)

Box 3

53 incidents where the job in hand was probably being done incorrectly. (Maintenance related.)

The environment plot had too few data points to draw any conclusions. (Little or no data was given in the OIR9A forms on environmental factors.)

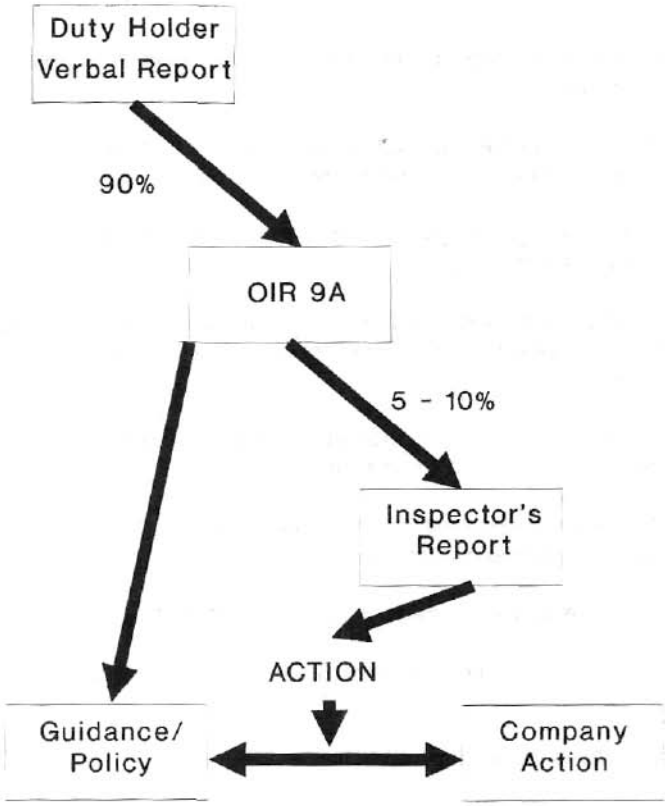
These plots indicate general groupings of the data in the database, and indicate an overall picture of the pattern of incidents.

For further investigations a database analysis tool was used which is capable of automatically formulating statistical rules from the patterns of data collected. Of particular interest are:

- 8% of incidents involved production situations where the maintenance may have been suspect on plant and machinery.
- 10% of incidents appeared to have been as a result of incorrect maintenance on plant and machinery.
- 13% of all incidents may be due to incorrect maintenance.
- 8% of incidents may have involved 'wear and tear' failures caused by inadequate maintenance.

Based on the results of this study it appears that:

- maintenance plays a significant part in offshore safety
- although incidents occur during maintenance, many more occur as a result of incorrect maintenance or the failure to carry out maintenance at all
- the pattern of maintenance and its effectiveness needs investigation, together with supervision and checking procedures.



Reporting Schematic

Figure 1

Maintenance Related
M1 - During Maintenance
M2 - Possibly Related to Maintenance
M3 - Not Related to Maintenance

Type of Operation
01 - Production
02 - Drilling/Workover
03 - Maintenance
  03a - Planned/Routine
  03b - Peformance Checks
  03c - Refit/overhaul
  03d - Defect repair
  03e - other
04 - Diving
05 - Construction/commissioning
06 - Deck Operations
07 - Domestic/catering
08 - Modification of plant/ structure
09 - Transport
010 - Other

Activity Leading to Incident
A1 - Portable tools/equipment
A2 - Manual lifting/handling
A3 - Plant Machinery
A4 - Scaffolding
A5 - Working height >2m
A6 - Climb/descend
A7 - Walking on level
A8 - Driving/piloting
A9 - Welding/burning
A10 - Hazard materials
A11 - Cleaning
A12 - Diving
A13 - Electrical Work
  A13a - Lighting
  A13b - Power and Distribution
  A13c - Other
A14 - Inspect/Examine
A15 - Other

Broad Incident Type
B1 - Loss of containment
B2 - Fire/explosion
B3 - Air transport
B4 - Sea transport
B5 - Slips/trips/falls
  B5a - Off ladders
  B5b - Through gratings etc
  B5c - Into sea
  B5d - Slip or loose footing
  B5e - Trip over obstacles
  B5f - Others
B6 - Falling objects
B7 - Handling materials
B8 - Hoists/lifts/cranes
B9 - Hand tools
B10 - Use Machinery
B11 - Exposure/contact
B12 - Diving related
B13 - Electrical
B14 - Structural/foundation
B15 - Mooring
B16 - Radiation
B17 - Other
B18 - Gas leakage
B19 - Oil leakage
B20 - Equipment failure
B21 - Damaged cables/fittings

Shortcomings
S1 - Supervision
S2 - Warning signs/ropes/etc
S3 - Precautions/dress/fuses
S4 - Slinging/straps
S5 - Wrong use of equipment
S6 - Safety harness
S7 - Maintenace done incorrectly
S8 - Maintenance overdue
S9 - Finger trouble
S10 - Wear and tear

Environment
E1 - Day time
E2 - Night time
E3 - Windy/high seas
E4 - Raining
E5 - Snowing
E6 - Icy
E7 - Fine
E8 - Dry
E9 - Wet/slippy

DATABASE CODES

Figure 2

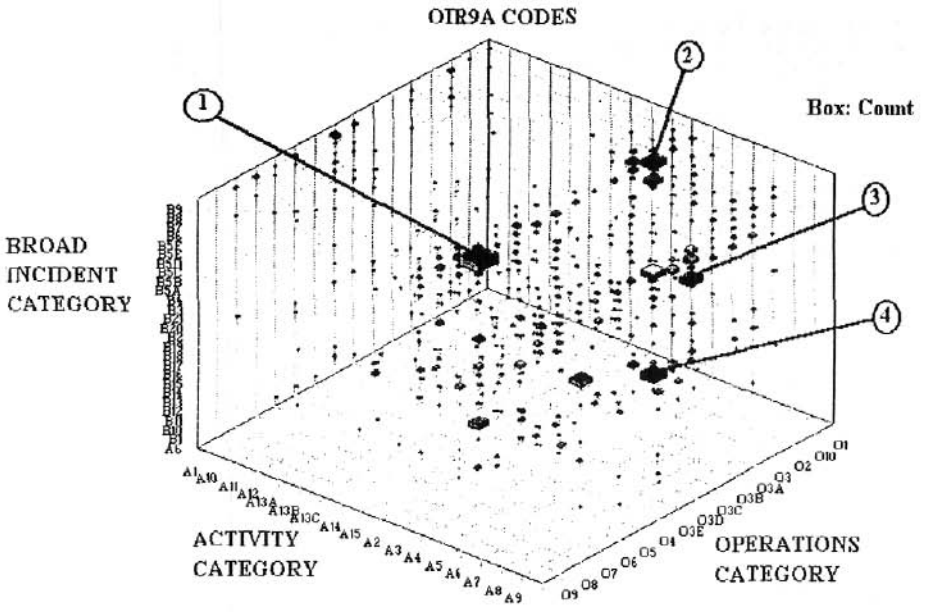


Figure 3

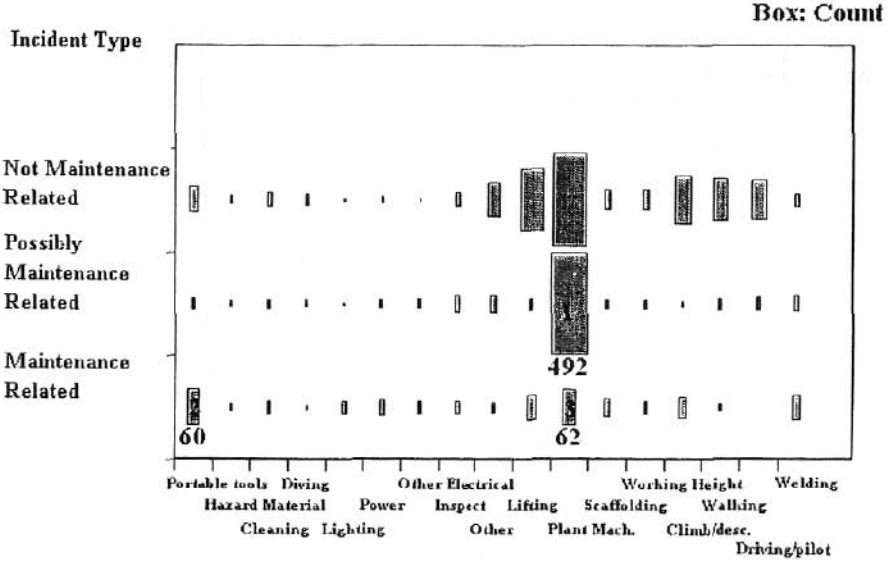


Figure 4

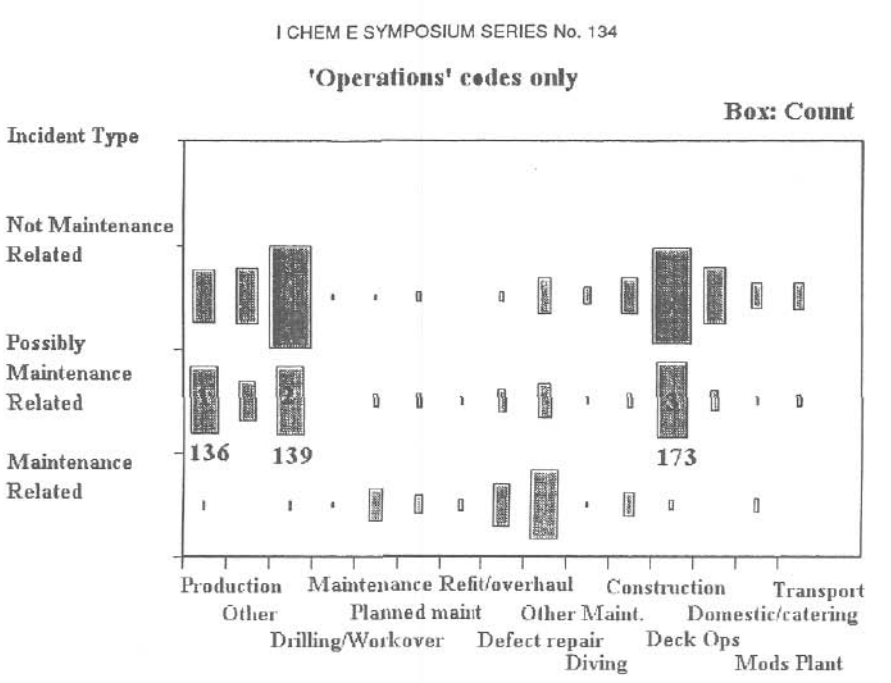


Figure 5

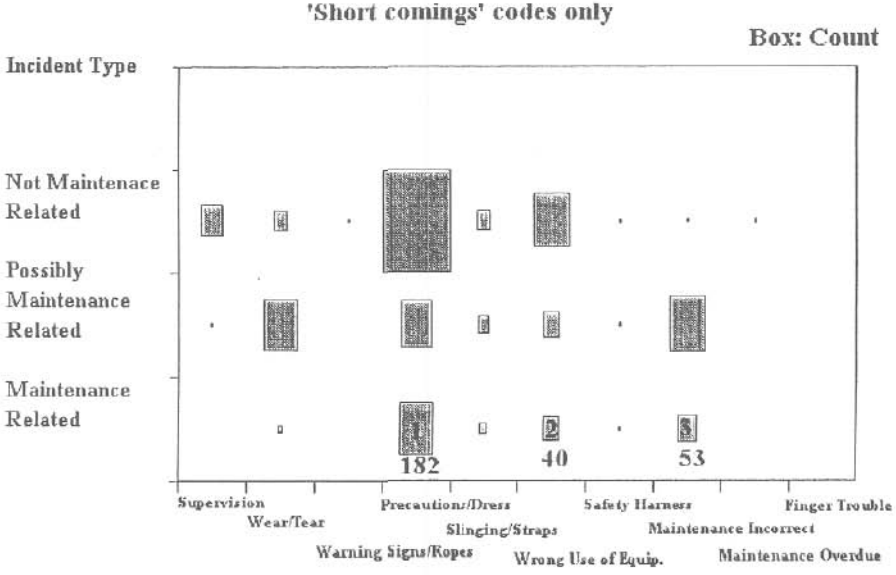


Figure 6