

*Star Princess* – Safety Centre

## ***Star Princess* – Safety Centre**

*Star Princess* has a highly automated system for managing ship emergencies. Sensors within the ship monitor the operation of key systems including the position of watertight openings, and existence of fires or flooding. This data is processed by a Safety Management System (SMS) workstations located on the bridge, and in the engine control room, main fire station, and safety centre. The safety centre is the preferred location for the command and control of emergencies, but it is possible to undertake these functions from any of the workstation locations.

The Safety Centre is located just aft of the Bridge and consists of a conference area and office space with three Safety Management System workstations. The centre is able to control or monitor:

- Fire detection
- General alarms and public address system
- Navigation and ship handling indication
- Engine management displays
- Ballast control and ship stability
- Control of watertight openings and the sliding Magradome roof on deck 14
- Closed Circuit Television system
- Emergency Shutdown System (ESD)

The ESD provides indication of running and stopped machinery, control of ventilation stops and dampers, shutdown of combustible liquids pumps, control of overboard discharge pumps, shutdown of air conditioning and ventilation systems, control of shell valves, closure of fire doors, indication of side door status, shutdown of shaft line lubrication pumps, remote control of CO<sub>2</sub> drench panel, bunker station panels,

The Safety Centre also has copies of ship's drawings and computer workstations for two secretaries. Both UHF and VHF communications are available, and the ship's main communications facilities are located nearby. Data from the SMS and voice recordings within the Safety Centre are routed to the ship's VDR in accordance with SOLAS requirements.

Summary of damage  
(Detailing number of cabins affected and damage caused)

[illegible]

**Extracts from SOLAS II-2**

## Extracts From SOLAS Chapter II – 2

### Definitions:

*'A' class divisions* are those divisions formed by bulkheads and decks which comply with the following criteria:

- .1 they are constructed of steel or other equivalent material;
- .2 they are suitably stiffened;
- .3 they are insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature, at any point, including any joint, rise more than 180°C above the original temperature, within the time listed below.

|              |        |
|--------------|--------|
| class 'A-60' | 60 min |
| class 'A-30' | 30 min |
| class 'A-15' | 15 min |
| class 'A-0'  | 0 min  |

- .4 they are also constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test; and
- .5 the Administration required a test of a prototype bulkhead or deck in accordance with the Fire Test Procedures Code to ensure that it meets the above requirements for integrity and temperature rise.

*'B' class divisions* are those divisions formed by bulkheads, decks, ceilings or linings which comply with the following criteria:

- .1 they are constructed of approved non-combustible materials and all materials used in the construction and erection of 'B' class divisions are non-combustible, with the exception that combustible veneers may be permitted provided they meet other appropriate requirements of this chapter;
- .2 they have an insulation value such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any point, including any joint, rise more than 225°C above the original temperature, within the time listed below;

|              |        |
|--------------|--------|
| class 'B-15' | 15 min |
| class 'B-0'  | 0 min  |

- .3 they are so constructed as to be capable of preventing the passage of flame to the end of the first half hour of the standard fire test; and
- .4 the Administration required a test of a prototype bulkhead or deck in accordance with the Fire Test Procedures Code to ensure that it meets the above requirements for integrity and temperature rise.

*'C' class divisions* are divisions constructed of approved non-combustible materials. They need meet neither requirements relative to the passage of smoke and flame nor limitations relative to the temperature rise. Combustible veneers are permitted provided they meet the requirements of this chapter.

Table 9.1 – Bulkheads not bounding either main vertical zones or horizontal zones

| Spaces   | (1)              | (2)              | (3)  | (4)  | (5) | (6)                 | (7)                 | (8)                 | (9)              | (10)             | (11)              | (12)              | (13)              | (14)              |
|--|------------------|------------------|------|------|-----|---------------------|---------------------|---------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| Control stations   | B-0 <sup>a</sup> | A-0              | A-0  | A-0  | A-0 | A-60                | A-60                | A-60                | A-0              | A-0              | A-60              | A-60              | A-60              | A-60              |
| Stairways  |                  | A-0 <sup>a</sup> | A-0  | A-0  | A-0 | A-0                 | A-15                | A-15                | A-0 <sup>c</sup> | A-0              | A-15              | A-30              | A-15              | A-30              |
| Corridors  |                  |                  | B-15 | A-60 | A-0 | B-15                | B-15                | B-15                | B-15             | A-0              | A-15              | A-30              | A-0               | A-30              |
| Evacuation stations and external escape routes   |                  |                  |      |      | A-0 | A-60 <sup>b,d</sup> | A-60 <sup>b,d</sup> | A-60 <sup>b,d</sup> | A-0 <sup>d</sup> | A-0              | A-60 <sup>b</sup> | A-60 <sup>b</sup> | A-60 <sup>b</sup> | A-60 <sup>b</sup> |
| Open deck spaces   |                  |                  |      |      |     | A-0                 | A-0                 | A-0                 | A-0              | A-0              | A-0               | A-0               | A-0               | A-0               |
| Accommodation spaces of minor fire risk  |                  |                  |      |      |     | B-0                 | B-0                 | B-0                 | C                | A-0              | A-0               | A-30              | A-0               | A-30              |
| Accommodation spaces of moderate fire risk   |                  |                  |      |      |     |                     | B-0                 | B-0                 | C                | A-0              | A-15              | A-60              | A-15              | A-60              |
| Accommodation spaces of greater fire risk  |                  |                  |      |      |     |                     |                     | B-0                 | C                | A-0              | A-30              | A-60              | A-15              | A-60              |
| Sanitary and similar spaces  |                  |                  |      |      |     |                     |                     |                     | C                | A-0              | A-0               | A-0               | A-0               | A-0               |
| Tanks, voids and auxiliary machinery spaces having little or no fire risk  |                  |                  |      |      |     |                     |                     |                     |                  | A-0 <sup>a</sup> | A-0               | A-0               | A-0               | A-0               |
| Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk |                  |                  |      |      |     |                     |                     |                     |                  |                  | A-0 <sup>a</sup>  | A-0               | A-0               | A-15              |
| Machinery spaces and main galleys  |                  |                  |      |      |     |                     |                     |                     |                  |                  |                   | A-0 <sup>a</sup>  | A-0               | A-60              |
| Store-rooms, workshops, pantries, etc.   |                  |                  |      |      |     |                     |                     |                     |                  |                  |                   |                   | A-0 <sup>a</sup>  | A-0               |
| Other spaces in which flammable liquids are stowed   |                  |                  |      |      |     |                     |                     |                     |                  |                  |                   |                   |                   | A-30              |

See notes following table 9.2.

Table 9.2 – Decks not forming steps in main vertical zones nor bounding horizontal zones

| Space below ↓  | Space above → | (1)  | (2)  | (3)              | (4)  | (5) | (6)  | (7)  | (8)  | (9) | (10)             | (11)             | (12)              | (13) | (14) |
|--|---------------|------|------|------------------|------|-----|------|------|------|-----|------------------|------------------|-------------------|------|------|
| Control stations   | (1)           | A-30 | A-30 | A-15             | A-0  | A-0 | A-0  | A-15 | A-30 | A-0 | A-0              | A-0              | A-60              | A-0  | A-60 |
| Stairways  | (2)           | A-0  | A-0  | A-0              | A-0  | A-0 | A-0  | A-0  | A-0  | A-0 | A-0              | A-0              | A-30              | A-0  | A-30 |
| Corridors  | (3)           | A-15 | A-0  | A-0 <sup>a</sup> | A-60 | A-0 | A-0  | A-15 | A-15 | A-0 | A-0              | A-0              | A-30              | A-0  | A-30 |
| Evacuation stations and external escape routes   | (4)           | A-0  | A-0  | A-0              | A-0  | -   | A-0  | A-0  | A-0  | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Open deck spaces   | (5)           | A-0  | A-0  | A-0              | A-0  | -   | A-0  | A-0  | A-0  | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Accommodation spaces of minor fire risk  | (6)           | A-60 | A-15 | A-0              | A-60 | A-0 | A-0  | A-0  | A-0  | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Accommodation spaces of moderate fire risk   | (7)           | A-60 | A-15 | A-15             | A-60 | A-0 | A-0  | A-15 | A-15 | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Accommodation spaces of greater fire risk  | (8)           | A-60 | A-15 | A-15             | A-60 | A-0 | A-15 | A-15 | A-30 | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Sanitary and similar spaces  | (9)           | A-0  | A-0  | A-0              | A-0  | A-0 | A-0  | A-0  | A-0  | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Tanks, voids and auxiliary machinery spaces(10) having little or no fire risk                                      | (10)          | A-0  | A-0  | A-0              | A-0  | A-0 | A-0  | A-0  | A-0  | A-0 | A-0 <sup>a</sup> | A-0              | A-0               | A-0  | A-0  |
| Auxiliary machinery spaces, cargo spaces, cargo and other oil tanks and other similar spaces of moderate fire risk | (11)          | A-60 | A-60 | A-60             | A-60 | A-0 | A-0  | A-15 | A-30 | A-0 | A-0              | A-0 <sup>a</sup> | A-0               | A-0  | A-30 |
| Machinery spaces and main galleys  | (12)          | A-60 | A-60 | A-60             | A-60 | A-0 | A-60 | A-60 | A-60 | A-0 | A-0              | A-30             | A-30 <sup>a</sup> | A-0  | A-60 |
| Store-rooms, workshops, pantries, etc.   | (13)          | A-60 | A-30 | A-15             | A-60 | A-0 | A-15 | A-30 | A-30 | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |
| Other spaces in which flammable liquids are stowed   | (14)          | A-60 | A-60 | A-60             | A-60 | A-0 | A-30 | A-60 | A-60 | A-0 | A-0              | A-0              | A-0               | A-0  | A-0  |

Notes: To be applied to tables 9.1 and 9.2, as appropriate.

- Where adjacent spaces are in the same numerical category and superscript “a” appears, a bulkhead or deck between such spaces need not be fitted if deemed unnecessary by the Administration. For example, in category (12) a bulkhead need not be required between a galley and its annexed pantries provided the pantry bulkhead and decks maintain the integrity of the galley boundaries. A bulkhead is, however, required between a galley and machinery space even though both spaces are in category (12).
- The ship’s side, to the waterline in the lightest seagoing condition, superstructure and deckhouse sides situated below and adjacent to liferafts and evacuation slides may be reduced to “A-30”.
- Where public toilets are installed completely within the stairway enclosure, the public toilet bulkhead within the stairway enclosure can be of “B” class integrity.
- Where spaces of categories (6), (7), (8) and (9) are located completely within the outer perimeter of the assembly station, the bulkheads of these spaces are allowed to be of “B-0” class integrity. Control positions for audio, video and light installations may be considered as part of the assembly station.



Observations from Warsash reconstruction

## Phase Three – Review of reconstruction

A DVD was provided by the MAIB showing a test carried out at the Warsash Fire Training facility. We understand that this test was undertaken as a reconstruction of a proposed scenario arising from the Star Princess accident. The table below provides a timeline summary taken from the DVD.

### Warsash Fire Test

| Time (min:sec) | OBSERVATIONS   |
|----------------|--|
| 00:00          | Ignition of towel located on chair.  |
| 00:53          | Flames about 0.5m in height.   |
| 01:19          | Towel on back of chair alight. Flames up to height of chair.                                 |
| 01:38          | Flames touching privacy panel.   |
| 01:53          | 80 % of towel involved in fire   |
| 01:59          | Char / soot deposition on privacy panel.   |
| 02:22          | Ignition of privacy panel.   |
| 02:35          | Flaming droplets observed between privacy panel and chair                                    |
| 02:57          | Entire back of chair fully involved in fire. Flames attacking outer chair seat.              |
| 03:11          | Flames on floor.   |
| 03:34          | Ignition of left arm support of inner chair. Partial collapse of back rest of inner chair.   |
| 03:57          | Total collapse of above back rest causing increase in flaming in left corner of compartment. |
| 04:26          | Thick black smoke developing.  |
| 04:41          | Windy conditions causing smoke logging.  |
| 05:11          | Wind pushing smoke into the left hand side compartment                                       |

|       |   |
|-------|---|
| 05:15 | Flames about 1m above chair height. Flaming becoming more vigorous due to windy conditions.                     |
| 05:41 | Flames to top of privacy panel. Soot or charring on outer chair left arm rest. Flames jetting up privacy panel. |
| 05:53 | Inner chair left arm rest fully involved in fire.   |
| 06:04 | Inner chair collapses backwards into left corner of room.   |
| 06:15 | Flames spreading onto outer chair. Underside of left arm rest starting to melt.                                 |
| 06:20 | Ignition of left hand side of outer chair.  |
| 06:28 | Inner chair fully collapsed into fire on floor.   |
| 06:32 | Ignition of back of outer chair.  |
| 06:45 | Left hand arm rest of outer chair collapses.  |
| 06:46 | Flame attacking Table.  |
| 06:59 | Outer chair seat collapse.  |
| 07:03 | Partial collapse of outer chair back rest. Flames about 1m above privacy panel.                                 |
| 07:05 | Momentary flame penetration through privacy screen  |
| 07:12 | Edge of table melting and dripping.   |
| 07:15 | Ignition of droplets on floor below table.  |
| 07:17 | Outer chair collapses.  |
| 07:24 | Ignition of table edge.   |
| 07:29 | Ignition of entire table support.   |
| 07:31 | Further flame penetration through privacy screen. High wind speed circulating smoke within compartment.         |

|       |  |
|-------|--|
| 07:48 | Table fully alight.  |
| 08:18 | Privacy screen fully involved in fire.   |
| 08:28 | Front edges of chairs on opposite side of room ignited.  |
| 08:52 | Flaming droplets from above chairs.  |
| 09:05 | Flame spread across floor up to chairs opposite.   |
| 09:26 | Sustained flame penetration of privacy screen into neighbouring right hand compartment with flaming droplets falling to floor. |
| 09:42 | Entire contents of room involved in fire.  |
| 09:43 | Large amounts of burning debris from privacy screen falling to floor of compartment  |
| 10:07 | Significant flame spread on the floor of the fire room   |
| 10:20 | Both chairs near the wall opposite the seat of ignition are fully involved in fire.  |
| 10:24 | Upper quarter of privacy screen closest to the outer edge of the compartment burning.  |
| 11:22 | Ignition of lower part of privacy screen on opposite side of the compartment to original ignition                              |
| 11:40 | Flame spread now fully across fire room floor. Flames to full height of the above privacy screen.                              |
| 13:56 | Remaining section of first privacy screen collapses.   |
| 14:06 | Outer half of opposite privacy screen ignited.   |
| 14:16 | Flame penetration of opposite screen with burning debris falling onto the floor of the adjoining compartment (RHS).            |
| 14:32 | Wind pushing flames from fire room through adjoining privacy screen.   |
| 16:09 | Flames rising up other side of neighbouring panel.   |
| 17:10 | Part of opposite screen falls to floor.  |

|       |                                 |
|-------|---------------------------------|
| 17:27 | Other half of screen collapses. |
| 18:27 | Water applied to fire.          |
| 18:37 | Fire extinguished               |



T+ 1 min



T+ 2 min



T+ 3 min



T+ 4 min



T+ 5 min



T+ 7 min



T+ 8.5 min



T+ 10 min



T+ 11.5 min



T+ 13.5 min



T+ 18 min

Extracts of BRE test results

## **Extracts from BRE test results**

The following information has been reproduced from the BRE report 229802 dated 17 July 2006.

### **Executive Summary**

Following a serious fire onboard the cruise ship Star Princess during the night of 23<sup>rd</sup> March 2006. BRE were commissioned by the MAIB to provide testing and consultancy services to support their investigation into this accident.

This report brings together:

- The data derived from a programme of fire tests on the materials provided by the MAIB investigation team.
- An overview of the contribution to the fire made by the products tested as part of this project.

An experimental programme was undertaken in two phases, each addressing the issues related to the accident:

1. Phase One – cigarette / towel ignition scenarios
2. Phase Two – fire growth characteristics

From the results it could be seen that the materials removed by the MAIB from the Star Princess following the accident all exhibited a range of fire performance characteristics which seemed consistent with the findings from the Warsash reconstruction test.

BRE is a wholly owned subsidiary company of the BRE Trust. This ownership structure enables BRE to be held as a national asset on behalf of the construction industry and its clients, independent of specific commercial interests, and protects BRE's impartiality and objectivity in research and advice. BRE Testing activities are undertaken under UKAS accreditation where appropriate.

### **Discussion**

The data from the ignition trials showed that sustained ignition was observed in only one case, that of the testing of the lighter weight green towelling. In all scenarios involving both the green and blue and white striped towelling, glowing combustion of the towelling was observed.

As presented in the phase one test results, the green towelling was used to provide some initial indications of potential combustion behaviour which could be used to develop the test programme with the limited amount of blue and white striped towels taken from the Star Princess after the accident. The green towelling material had a slightly lower mass per unit area than the towelling taken from Star Princess after the accident and this may have influenced the transition to flaming ignition that was observed. This transition to flaming ignition could not be repeated with the blue and white striped towelling taken from the Star Princess after the accident.

As with any fire propagation process, the effect of ambient conditions such as wind speed / direction, humidity and local air temperatures can influence the ignition process and hence transition from glowing to flaming combustion. Due to the limited quantities of material available from the accident, a full study of the potential ignition transfer from smouldering cigarette to flaming combustion of secondary items such as towelling was not possible at full-scale. Therefore the ignition scenario trials were all carried out using very limited quantities of available materials.

Additionally, other products such as clothing including swimming costumes and trainers may also have been present at the time of the accident and could have influenced the transition from smouldering to



flaming ignition. This is because of the different ignition characteristics of these materials. Since samples of these materials were not available this process was not investigated as part of this study.

A limited number of tests also considered the potential ignition transfer route from cigarette to balcony furniture either directly or via the towelling material. Again whilst glowing combustion was observed, transition to flaming ignition from the cigarette to other elements was not observed.

Based on the Warsash reconstruction footage it can be seen that once sustained ignition of the towelling material occurred, the fire propagation rate was rapid. The results from the indicative cone calorimeter tests show that for both the furniture and decking materials the minimum piloted irradiance levels were below  $15 \text{ kW/m}^2$  to establish sustained ignition and the balcony partition ignited at around  $25 \text{ kW/m}^2$ . Once ignited all of these products generated comparatively high levels of heat release which would have assisted in the rapid propagation of the fire as reported in the accident.

The data from the cementitious decking screed also suggests that it contained a high level of polymeric material. This product is likely to have contributed to the fire load and localised combustion via the evolution of volatiles from the polymer content.

The data from the smoke and toxicity tests show that the levels of smoke generated were significantly greater than those defined as acceptable under the FTP criteria for similar products used within a vessel. Although it should be noted that the toxic species identified were not at levels close to the limits set in the code. The assessment of toxicity in any fire event is dependent upon a number of parameters such as ventilation conditions and combustion temperatures. Any standard fire test can only be used to rank the performance of products under a fixed scenario. The standard fire test scenario may not be representative of the specific conditions that occurred during the Star Princess accident and therefore the values of toxicity cannot be considered as representative of the actual event.

## Fire growth characteristics

This phase of the programme was designed to use test methodologies that could provide the most relevant data using the limited quantity of material available. Existing SOLAS requirements for the materials were used where possible, however, it should be noted that these are for materials used within a ship. The materials that are the subject of this investigation (with the exception of the curtains), were located on external balconies.

Under the current SOLAS requirements, Table 1 summarises the test programme that would have been expected for such products. Where SOLAS requirements could not be followed, a note is provided and the alternative method used is detailed. The individual reports for each of the tests undertaken have been presented separately. A summary of the findings are given below.

### Summary of SOLAS requirements

| Product type / application            | SOLAS test (IMO MSC 61 (67) Annex 1)  | Test undertaken   |
|---------------------------------------|---|---|
| Bathing towels                        | No formal requirement   | As detailed in this report  |
| Curtains                              | Part 7 – Vertically supported textiles and films  | IMO MSC 61 (67) Annex 1 Part 7  |
| Balcony Furniture                     | Part 2 – Smoke and Toxicity   | IMO - Part 2 – Smoke and Toxicity   |
|                                       | Part 5 – surface flammability   | Insufficient material to undertake IMO test. Cone calorimetry (ISO 5660-1) was used to provide information on heat release and critical flux. |
| Polycarbonate based balcony partition | Part 2 – Smoke and Toxicity   | IMO - Part 2 – Smoke and Toxicity   |
|                                       | Part 5 – surface flammability   | Insufficient material to undertake IMO test. Cone calorimetry (ISO 5660-1) was used to provide information on heat release and critical flux. |
| Blue polypropylene based deck tile    | Part 2 – Smoke and Toxicity   | IMO - Part 2 – Smoke and Toxicity   |
|                                       | Part 5 – surface flammability   | Insufficient material to undertake IMO test. Cone calorimetry (ISO 5660-1) was used to provide information on heat release and critical flux. |
| cementitious decking screed           | Depending upon the final application and physical nature of the product it may require testing for either non-combustibility Resolution A.472 (XII) or surface flammability Resolution A.653 (16) | Insufficient material for any IMO test method. BS EN ISO 1716:2002 was used to determine the gross calorific value.                           |

## Results

### Test for Surface Flammability

The test specified in the FTP code Annex 1 part 5 for assessing the surface flammability characteristics calls upon IMO Resolution A.653(16). The code utilises this test method for determining the fire performance characteristics of bulkhead, ceiling and deck finish materials. It also makes reference to its use for assessing products that are required to have low flame-spread characteristics. Whilst the furniture may not typically be expected to conform with the requirements both the balcony partition and polypropylene - based deck tile could be considered as materials suitable for assessment by this technique.

The test method utilises a radiant panel and pilot flame to determine the critical flux at extinguishment for a given sample and by monitoring the temperature of the combustion gases being given off during the test, the heat release from the sample is also determined. The test requires specimens 155mm (+0 / -5) by 800mm (+0 / -5). Since there was insufficient sample to complete these tests, the cone calorimeter (ISO 5660-1:2002) was used as it requires 100 mm square samples and could provide some data on the heat release characteristics of the product and the heat flux levels for ignition.

#### Summary of cone (ISO 5660-1) test results.

| Product                           | Total Heat released<br>(MJ/m <sup>2</sup> ) | piloted ignition<br>flux level<br>(kW/m <sup>2</sup> ) | Notes  |
|-----------------------------------|---|--|--|
| Balcony Furniture                 | 179 @ 25 kW/m <sup>2</sup>                  | 15-7   | no ignition at 7 kW/m <sup>2</sup> – significant levels of smoke production  |
| Polypropylene - based deck tile   | 150 @ 25 kW/m <sup>2</sup>                  | 15-10  | no ignition at 10 kW/m <sup>2</sup> – significant levels of smoke production |
| Polycarbonate - balcony partition | 253 @ 25 kW/m <sup>2</sup>                  | 25   | Significant intumescenting of the product                                    |

From the data it can be seen that the minimum piloted ignition flux level for both the white slatted foot rest and polypropylene - based deck tile are below 15 kW/m<sup>2</sup> based on the cone calorimeter data. In both cases the samples melted prior to their ignition, producing a liquid pool fire within the sample tray. This supports the observations from the Warsash reconstruction tests.

The polycarbonate - based balcony partition did not readily ignite with piloted ignition at 25 kW/m<sup>2</sup>, which was consistent with the smoke and toxicity test. The product surface appeared to intumesce and char over. However, the continued application of the radiant heat and pilot ignition lead to the failure of the char and the specimen subsequently ignited and supported its own rigorous combustion to extinction.

The data obtained from the IMO spread of flame test is not directly comparable with that produced by the Cone calorimeter. As an example, a polymeric floor tile may generate a total heat release of around 1.5 MJ in the IMO test and around 55 MJ/m<sup>2</sup> in the cone calorimeter. The key factors behind these differences arise from the irradiance distribution across the surface of the specimen in the IMO test compared with the cone calorimeter for which the irradiance level is constant over the surface of the specimen. In addition, the cone calorimeter is based on oxygen depletion and the IMO is based on temperature measurements in the

exhaust duct. It is therefore not possible to comment directly upon the potential performance of these products in the cone calorimeter under the FTP performance criteria set in annex 5.

### **Deck Screed Cementious Material**

The material as supplied appeared to be a friable aggregate product. Since insufficient material could be supplied to undertake either the IMO non-combustible test (Part 1) or the test for surface flammability (part 5) it was considered that the BS EN ISO 1716:2002 could be used to provide some useful information regarding the gross calorific value (PCS) associated with this sample.

The result from this indicative test shows that the Gross Calorific Value for this product (PCS) was 24.9 MJ/kg.

The results from this test suggests that the sample has the potential to contribute to the overall fire load if it became involved in any incident. This data does not provide any information on the ignitability or rate of combustion that might be expected to be generated by the sample.

### **Smoke and Toxicity**

Three of the samples supplied from the accident were tested for their smoke and toxicity characteristics utilising the principles set out Resolution MSC.61(67): Annex 1 Part 2.

The materials tested came from:

1. Balcony furniture.
2. Blue polypropylene - based deck tiles.
3. Polycarbonate - based balcony partition.

### **Smoke**

Under the FTP code requirements in Annex 1 part 2, '*...an average ( $D_m$ ) of the maximum of  $D_s$  of three tests at each test condition shall be calculated.*' Based on the  $D_m$  value four categories of performance are suggested ranging from 200 for some lining conditions to 500 for flooring coverings. Since only a limited number of experimental runs could be undertaken the assessment against  $D_m$  has been made against  $D_s$  for this study.

Two specimens of each sample were initially tested at an irradiance of 25 kW/m<sup>2</sup> without pilot ignition. Where the  $D_s$  limit for smoke was not exceeded, the samples were then retested, at an irradiance of 25 kW/m<sup>2</sup> with a pilot ignition. As can be seen from Tables 5 and 6 the furniture and polypropylene - based deck tiles exceeded the  $D_s$  500 level, under the first exposure condition. The polycarbonate - based balcony screen was tested at this irradiance level with pilot ignition and both specimens exceeded the  $D_s$  500 level within 8 minutes.

In all cases the specimens melted at the 25 kW/m<sup>2</sup> irradiance level and the white slatted foot rest was found to self ignite under these conditions. The deck tile did not self ignite during the test but when the extract system was opened to clear the chamber, ignition of the specimen and smoke was observed. Only the polycarbonate - based balcony partition required piloted ignition to produce optical density levels exceeding  $D_s$  500.

All the specimens supplied by MAIB showed the potential to fail to meet the performance requirements set in the code for smoke production in all end use applications, if tested to the full requirement of the code.

### Smoke, Balcony Furniture

| Test Condition                     | Specimen 1          | Specimen 2          | Observation   | Indicative results in relation to code requirements                                 |
|------------------------------------|---------------------|---------------------|---|---|
|                                    | $D_s$               | $D_s$               |   |   |
|                                    | [Time to $D_s$ (s)] | [Time to $D_s$ (s)] |   |   |
| 25kW/m <sup>2</sup> no pilot flame | 796.81              | 894.2               | Specimen melted. Self ignition of specimen observed at 6 minutes 59 seconds,<br><br>Black smoke and black settlement found on the smoke chamber | $D_s$ value exceeded $D_m$ limits for all applications – No further samples tested. |
|                                    | [ 579 ]             | [546 ]              |   |   |

### Smoke, Blue polypropylene based deck tiles

| Test Condition  | Specimen 1          | Specimen 2          | Observation   | Indicative results in relation to code requirements                                 |
|---|---------------------|---------------------|---|---|
|   | $D_s$               | $D_s$               |   |   |
|   | [Time to $D_m$ (s)] | [Time to $D_m$ (s)] |   |   |
| Irradiance of 25kW/m <sup>2</sup> in the absence of pilot flame | 1285.97             | 1284.44             | Specimen melted, no self ignition but the smoke reached the maximum and test stopped at 10 minutes – sample and smoke ignited when extract was switched on. | $D_s$ value exceeded $D_m$ limits for all applications – No further samples tested. |
|   | [ 434 ]             | [503 ]              |   |   |

### Smoke, White Polycarbonate balcony partition

| Test Condition   | Specimen 1          | Specimen 2          | Observation   | Indicative results in relation to code requirements                                 |
|--|---------------------|---------------------|---|---|
|  | $D_m$               | $D_m$               |   |   |
|  | [Time to $D_m$ (s)] | [Time to $D_m$ (s)] |   |   |
| Irradiance of 25kW/m <sup>2</sup> in the absence of pilot flame  | 107.33              | 144.77              | Specimen melted, no self ignition   | $D_s$ value did not exceed $D_m$ limits   |
|  | [ 1200 ]            | [1200 ]             |   |   |
| Irradiance of 25kW/m <sup>2</sup> in the presence of pilot flame | 1270.95             | 1265.27             | Specimen melted and self ignition of specimen observed at 2 minutes 54 seconds, Black smoke and black settlement found on the smoke chamber | $D_s$ value exceeded $D_m$ limits for all applications – No further samples tested. |
|  | [ 416 ]             | [ 461 ]             |   |   |

## Toxicity

None of the specimens tested indicatively under this study exceeded the limits set in the FTP code. Based on this indicative data, Hydrogen Fluoride, Hydrogen Bromide, Hydrogen Cyanide and Sulphur dioxide were not identified in any of the samples tested under these limited exposure conditions used.

### Toxicity, Balcony Furniture

| Species           | Limit of Gas Concentration (ppm) | Calculated gas concentration – irradiance of 25kW/m <sup>2</sup> in the absence of pilot flame (ppm) |
|-------------------|----------------------------------|--|
| Carbon monoxide   | 1450                             | 571  |
| Hydrogen fluoride | 600                              | NDA  |
| Hydrogen chloride | 600                              | 5.60   |
| Hydrogen bromide  | 600                              | NDA  |
| Hydrogen cyanide  | 140                              | NDA  |
| Nitrogen dioxide  | 350                              | 2  |
| Sulphur dioxide   | 120                              | NDA  |

**Notes:** Limit of detection for HF, HCl, HBr was 0.1mg/l. NDA = No detectable amount

### Toxicity, Blue polypropylene based deck tiles

| Species           | Limit of Gas Concentration (ppm) | Calculated gas concentration – irradiance of 25kW/m <sup>2</sup> in the absence of pilot flame (ppm) |
|-------------------|----------------------------------|--|
| Carbon monoxide   | 1450                             | 591  |
| Hydrogen fluoride | 600                              | NDA  |
| Hydrogen chloride | 600                              | 5.27   |
| Hydrogen bromide  | 600                              | NDA  |
| Hydrogen cyanide  | 140                              | NDA  |
| Nitrogen dioxide  | 350                              | 3  |
| Sulphur dioxide   | 120                              | NDA  |

**Note :** Limit of detection for HF, HCl, HBr was 0.1mg/l. NDA = No detectable amount

### Toxicity, White Polycarbonate balcony partition

| Species           | Limit of Gas Concentration (ppm) | Calculated gas concentration – irradiance of 25kW/m <sup>2</sup> in the absence of pilot flame (ppm) | Calculated gas concentration – irradiance of 25kW/m <sup>2</sup> in the presence of pilot flame (ppm) |
|-------------------|----------------------------------|--|---|
| Carbon monoxide   | 1450                             | 85   | 875   |
| Hydrogen fluoride | 600                              | NDA  | NDA   |
| Hydrogen chloride | 600                              | 5.27   | 5.60  |
| Hydrogen bromide  | 600                              | NDA  | NDA   |
| Hydrogen cyanide  | 140                              | NDA  | NDA   |
| Nitrogen dioxide  | 350                              | <1   | 7   |
| Sulphur dioxide   | 120                              | NDA  | NDA   |

**Note :** Limit of detection for HF, HCl, HBr was 0.1mg/l. NDA = No detectable amount

Extracts from *Star Princess* Emergency Response Organisation





## **INTRODUCTION**

This is intended as an insight into how the Emergency Response Organization (ERO) should be managed and used on board. Detailed instructions are contained within each appropriate section.

The ERO has been written to standardise the operating procedures and format throughout the fleet and to conform to legislation.

ERO 1+2 contain details of emergency procedures and the personnel designated to each emergency duty.

The naming of ranks within each department has been made as generic as possible, thereby giving more flexibility whilst assigning emergency duties within that ranks range of duties. It is the responsibility of each department head to ensure that the most suitable person is designated to the most appropriate emergency duty, and that they hold the correct emergency card.

## **STAGES IN AN EMERGENCY**

**ASSESSMENT PARTY** – The Assessment Party is a group of key personnel that investigate and evaluate any reported or suspected incident. They determine the severity and recommend to the Command Team if Crew Alert or General Emergency Stations should be called. When the Assessment Party is called, the Deck Fire and Engine Fire Parties should muster, don equipment and await instructions.

**CREW ALERT** – The Crew Alert Signal is the continuous sounding of the ship's alarms. It signifies that all of the ship's company should proceed to their Crew Alert Station. At this stage, there must be a complete muster and positive report of all ships' company being at their Crew Alert Station. This is achieved by the reporting procedures detailed for each party in ERO 1, sections 1, 2, 3 & 4. Passengers are not involved at this stage but must be kept informed by frequent broadcasts.

**GENERAL EMERGENCY** – The general emergency signal is seven or more short blasts, and one long blast on the alarms and the ship's whistle. It signifies that passengers are now involved and should muster in the Muster Stations. Ship's company must continue with their Crew Alert duties.

When the passengers are clear of the stairways and mustered, the Stairway Guides must be relocated to their designated Muster Stations.

**BOAT MUSTER STATIONS** – This is given verbally from the Bridge. It signifies that all ship's company, except the Containment party, the lifeboat preparation party and the liferaft preparation parties, should proceed to their allocated Survival Craft station. At this stage, there must be another complete muster and positive report of all ships' company being at their Survival Craft station. Each Boat or Raft muster position has a member designated as Checker. This person must use the checkoff board to ensure that all personnel are present; they report this and any absentees to the Deck officer as each station is checked.

## **INTRODUCTION**

(cont'd)

When the decision is made to move passengers from the Muster Stations to Survival Craft, the Command Team should pass this on to the Passenger Services Director, who will inform the personnel in charge of each Muster Station.

**CONTAINMENT PARTY** – Consists of a group of key personnel that remains on board to contain the emergency, maintain essential services and oversee the evacuation. This party finally abandons ship on the Captain's order, after the complete evacuation of all other passengers and crew.

**ABANDON SHIP** – This is given verbally from the Bridge and is the order to commence the lowering of the Survival Craft.

## **EMERGENCY PARTIES**

**ON SCENE COMMANDER** – The Sr. 1<sup>st</sup> Officer is the On Scene Commander for all incidents outside the machinery spaces. The Staff Engineer is the On Scene Commander for all machinery space incidents.

**DECK FIRE PARTY** – Usually used as the lead fire party in accommodation area fires, the Engine Fire Party would be used as the back up party. Assist as required with damage control duties.

**ENGINE FIRE PARTY** – Usually used as the lead fire party in machinery space fires, the Deck Fire Party would be used as the back up party. It is the designated damage control party.

**CABA BOTTLE FILLING PARTY** – Used to deliver full and refill empty B.A. cylinders.

**HIGH EXPANSION FOAM PARTY** – Used to transport, set up, and use the foam machine.

**LIFEBOAT PREPARATION PARTIES** – Used to lower and prepare the lifeboats ready for boarding. Lifeboats are to be prepared at Crew Alert.

**LIFERAFT PREPARATION PARTIES** – Used for the preparation and launching of all liferafts. The Personnel designated to each davit when boat Muster Stations is called. They abandon in the last liferaft launched from their davit.

**PASSENGER ASSISTANCE PARTY** – Used to assist handicapped or infirm passengers from their cabins to their designated Muster Stations and from the Muster Station to the Survival Craft.

**STRETCHER PARTY** – Used to transport injured personnel to the Medical Center or Emergency Medical Center.

**MEDICAL CENTER PARTY** – Used to receive and treat injured personnel during an emergency.

**LIFEJACKET WORK PARTY** – Used to collect and deliver extra lifejackets, if required, to the Muster Stations. Passenger Muster Personnel must inform the Bridge of the number required. If the total number of lifejackets required is less than the number quoted on the Bridge Emergency Stations Check List, then they are to be collected from the spare Lifejacket Lockers on deck. If the number required exceeds this, the Command Team must broadcast for Section Leaders and section personnel to collect lifejackets from the passenger cabins and place them in the appropriate stair towers as stated on their Section Leader sheets, ready for collection by the Lifejacket Work Party.

## **INTRODUCTION**

(cont'd)

**WORK PARTIES** – Used to assist any of the other parties as instructed. In each work party there are a number of more senior personnel, that lead smaller sub-groups of the work parties to assist as required.

## **ZONE ORGANIZATION**

The ship is split up into Vertical Fire Zones, each zone having a Zone Commander and a Deputy Zone Commander. The Zone Commander or Deputy should always be present at his Zone Headquarters.

A Section Leader and section personnel are designated to each deck of that zone. These personnel initially muster, report and then carry out the duties on their instruction sheet.

The communications procedure is: Section Leaders pass reports to the Zone Commander/Deputy at the Zone Headquarters and then for routine matters, the Zone Commander/Deputy passes reports to the Zone Coordinator. The Zone Coordinator collates and relays these reports to the Command Team.

If a Zone Commander receives a report which is relevant to the incident, such as a hot spot, he should communicate it directly to the Command Team.

Zone Commanders and the Zone Coordinator have their own checklists. They must complete these as instructed and must retain them ready for collection at the conclusion of the emergency/drill.

## **PASSENGER MUSTER ORGANIZATION**

**MUSTER CONTROL PARTY** – Consists of the key personnel in the organization of passenger mustering and evacuation. They muster and check off by the Promenade Bar (**TEL. 7403**), before carrying out their duties. P23 AP/JAP 11, the Passenger Services Director's Assistant, remains by that telephone to assist in communications.

**STAIRWAY GUIDES** – A certain number of personnel are allocated to each stairway that passengers can be expected to use. They control and guide passengers in the stairways and to the Muster Stations. After the stairways are clear, they are relocated to assist in the Muster Stations.

**PASSENGER MUSTER PERSONNEL** – A certain number are allocated to each passenger muster station. These personnel assist in the mustering and control of the passengers within their muster station.

**DOOR CHECKERS** – Door checkers perform the duty of counting personnel out of the Muster station. They ensure that the correct number of passengers and guides are sent to the correct lifeboat or raft.

## **PASSENGER MUSTER PERSONNEL INSTRUCTION**

The crew member I/C of each Muster Station will check off the personnel designated to his Muster Station and then reports to the Muster Control Party (Promenade Bar – TEL. 7403).

### **SHIP'S ORGANIZATION**

In an emergency, passengers are mustered with lifejackets, warm clothing, head coverings and any medications they may be taking, at one of the four Muster Stations:

|                        |  |
|------------------------|--|
| MUSTER STATION "A":    | Princess Theater                           |
| MUSTER STATION "B":    | Tequila's, Hearts and Minds, Internet Café |
| MUSTER STATION "CFWD": | Explorers                                  |
| MUSTER STATION "CAFT": | Wheelhouse Bar, Sabitini's, Photo Gallery  |
| MUSTER STATION "D":    | Vista Show Lounge                          |

Should it become necessary to abandon ship, the officer in charge of each Muster Station will evacuate his room as per instructions in the ship's Emergency file, assisted by the Muster Personnel and Stairway Guides.

### **DUTIES**

At Crew Alert you should wear your lifejacket and hat correctly. You must be positive and clear with your instructions to passengers as they look to you for leadership and guidance.

The Crew Member In Charge or 2<sup>nd</sup> In Charge of the room will use a microphone or bull horn to give instructions and information to the passengers, however, all Passenger Muster Personnel will be required to participate and give out the more standard instructions.

Passengers must be instructed to:

- 1.) Fill the extremities of the room first
- 2.) Stay calm and quiet so that they can hear any instructions or information
- 3.) Put on their lifejackets

If you are short of lifejackets inform the Bridge/Safety Center (TEL. 14006) and they will be provided by the Lifejacket Work Party.

Spare lifejackets are situated on the outside of Deck 7 Port and Starboard.

Door Checkers are used to count the passengers out of the room to ensure the correct number go to each boat. The Door Checkers should be positioned at their designated exit door, inside the Muster Station, not outside.

Extract from Princess Cruises' fleet regulations



## P&amp;O PRINCESS

## FLEET REGULATIONS

## DECK STANDING ORDERS

## SAF.1 Procedures to Protect and Secure the Safety of Personnel

Safety

Reissued September 2003

## SAF.1.2 General Emergency Stations Broadcast

## 1. GENERAL EMERGENCY STATIONS BROADCAST

*Note: P&O Cruises version is in italics.*

The broadcast to passengers during passenger musters and abandon ship drills is to be given via audio tape from the bridge (Princess Cruises). On P&O Cruises ships, the Captain gives the broadcast. The contents are as follows:

1.1 May I have your attention, please, ladies and gentlemen (*or Captain's Introduction*).

1.2 Firstly, on behalf of all of us at Princess/[P&O Cruises,] I would like to welcome you on board [SHIP'S NAME] and hope that you have an enjoyable vacation/*cruise holiday*.

1.3 As your safety is our highest priority, I would now request your complete attention while I outline some important safety information.

1.4 The signal that you have just heard is the general emergency signal, which consists of seven short blasts followed by one long blast on the ship's whistle and alarms. This is the only signal that requires you to take action in an emergency and is used to call you to your Muster Station. A 'Muster Station' is an area of safety where passengers assemble in an emergency. The General Emergency Signal is not the signal to abandon ship. If you should hear this signal at any time, including when the ship is in port, without having been warned that drills are taking place, you should proceed to your stateroom/*cabin*, collect your lifejacket, warm clothing, a head covering and any medication that you normally use, then carrying your lifejacket go to the muster station which is specified on the safety notice by your stateroom/*cabin* door. The Muster Stations on [SHIP'S NAME] are located on deck number(s).... Guides will be positioned on the stairways to direct and assist you. Please walk quickly and quietly, and on stairways and in alleyways keep to the right.

1.5 If for any reason you are prevented from returning to your stateroom/*cabin*, you should go directly to your muster station. Once there, a lifejacket will be obtained for you by a crew member.

1.6 When you reach your muster station, you should wait quietly for the instructions and information that will be broadcast over the Public Address system or given to you by the officer in charge of the room. Do not put on your lifejacket until instructed to do so.

1.7 You may have noticed that we have not had a roll call. This is because we have developed an emergency search procedure that enables us to determine that you are all safe much more quickly than can be achieved with a roll call. However, all our Muster Stations are equipped with the appropriate lists and we would have a roll call if it was determined to be necessary.

1.8 In the unlikely event that it is necessary to abandon ship, an order will be given verbally from the bridge. The staff in your muster station will then divide you into groups and take you to the survival craft. In an emergency it is possible that the incident may last for some time. It is therefore our practice to muster passengers away from the elements in one of the lounges. Only if it is necessary to Abandon Ship will you be taken to embark in the Lifeboats and Liferafts.

1.9 Members of the Ship's Company will now indicate the exits from your Muster Station to the survival

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craft. In the event it is necessary to abandon ship, designated Door Checkers at each of these doors will direct the correct number of people to each of the survival craft. You would follow the guides who would lead you to your lifeboat or liferaft.

1.10 There are other signals which do not directly affect passengers. These alert the crew for specific duties and do not require any action by you. You will be given notice of any crew drills involving the use of these signals in the *Princess Patter/Ship's Daily Newspaper* and by broadcasts.

1.11 In the event of a fire and at drills, your route may be blocked by fire-proof doors. Although they are heavy, these doors may be opened by hand and will close automatically behind you. There are alternative exits from every passenger space and you should take a few moments to thoroughly familiarise yourself with the area surrounding your stateroom/cabin.

1.12 In the event of an emergency, a low-level guidance system will switch on automatically. If the visibility in your area is reduced so that you cannot see the normal exit signs, you should keep close to the floor and crawl if necessary. Follow the lighted strip and it will lead you to an exit. (Ships fitted with low location lighting only.)

1.13 It is important that you do not use the elevators/lifts in an emergency as you may become trapped in the event of a power failure.

1.14 If you have mobility difficulties and feel that you may need assistance in an emergency, we have people specially allocated to the task of looking after you. Let your Stateroom/Cabin Steward and the Purser's Office/Reception Desk know today in order that special arrangements can be made.

1.15 Should you smell smoke or discover a fire, press one of the red fire alarm buttons situated around the ship. This warns the bridge so that immediate action can be taken. Please note that you will not hear the alarm bells sound when you press the fire alarm.

1.16 If you should see anyone fall over the side, you should throw a lifebuoy or anything else that will float over the side, shout 'man overboard' and inform the nearest crew member.

1.17 In today's ever-changing world climate, the safety of our passengers and crew remains our utmost priority. To this end, all Princess/P&O ships operate under the highest level of security awareness.

1.18 Such procedures are designed to create a safe and comfortable onboard environment, resulting in as little intrusion as possible on our passengers' overall vacation experience/cruise.

1.19 Please be aware that the ship and her crew are fully prepared to deal with any out-of-the-ordinary situation that should arise, and will take all necessary action to the full extent of the law regarding such incidents, whether they are deemed real or fabricated.

1.20 We appreciate your strict attention and respect regarding this issue, as we continue to do our utmost to provide our passengers with a perfect vacation.

1.21 Please assist us to maintain the security of the ship by showing your cruise card to the member of the Ship's Company at the gangway when leaving or boarding the ship at each port. He may require to search your hand baggage. Do not carry on board any parcels or baggage for the benefit of a stranger. We regret having to restrict visitors to the ship, but you will appreciate that these simple precautions are necessary and we would ask for your cooperation.

There are areas that are marked for crew only. Please do not enter these areas even if you are invited by a crew member.

1.22 Never sit on the ship's side rails including those on stateroom balconies, or allow children to do so, even when holding them.

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1.23 Princess Cruises/P&O Cruises is committed to the protection of the environment so please do not throw anything over the side. This includes matches and cigarettes which can be drawn back into the ship and cause a fire.

1.24 If you would like more information about our Emergency Procedures, please ask at the Purser's Desk for a copy of our Emergency Procedures Information Sheet (for Princess Cruises ships).

*If you have any questions you wish to ask, officers and crew members will remain behind at the conclusion of this drill (for P&O Cruises ships).*

1.25 Please remain in position while a member of the Ship's Company demonstrates the correct wearing of the lifejacket. I repeat, please remain in position while a member of the Ship's Company demonstrates the correct wearing of the lifejacket.

#### 1.26 Detailed Instructions

1.27 It must be stressed that you should only take to the water as a last resort. If this becomes necessary, you should use the method now demonstrated by a crew member at your muster station. Using one hand, pinch your nose between your thumb and forefinger and place the palm over your mouth. Bring your other arm across and tightly grip the side or shoulder of the lifejacket, to stop it riding up as you enter the water. Check that there is nothing in the water below you. Look straight ahead and step off, do not jump.

1.28 Special lifejackets are available for children and infants weighing less than 70 lbs/32kgs. If these have not yet been provided, please ask your Stateroom/[Cabin] Steward.

1.29 On completion of today's instruction, please return your lifejackets to your stateroom and, if you have not already done so, read the notice concerning emergency procedures. To avoid tripping yourself or others, please ensure that the lifejacket straps do not trail on the deck.

1.30 Please now stand and put on your lifejacket. Members of the Ship's Company are in attendance to assist you.

### 2. INSTRUCTIONS FOR ROYAL PRINCESS

- 2.1 Place the lifejacket over your head, ensuring that your arms pass over the side tapes.
- 2.2 Draw the upper tapes tight and tie them securely in a bow across the centre of the front pad.
- 2.3 Cross the lower tapes behind your back.
- 2.4 Bring the lower tapes back to the front and tie securely in a bow, under the front pad.
- 2.5 There is a light on your lifejacket. This will activate automatically if you have to enter the water.
- 2.6 There is a whistle for attracting attention in a pocket on the side.

### 3. INSTRUCTIONS FOR REGAL PRINCESS

- 3.1 Put on the lifejacket like a waistcoat.
- 3.2 Connect the Velcro strips at the front.
- 3.3 Engage the upper and lower clips by pushing the two parts firmly together and pull tight.

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3.4 There is a light on your lifejacket. This will activate automatically if you have to enter the water.

3.5 There is a whistle for attracting attention in a pocket at the front.

#### 4. INSTRUCTIONS FOR SUN PRINCESS

4.1 Put on the lifejacket like a waistcoat.

4.2 Connect the Velcro strips at the front.

4.3 Engage the upper and lower clips by pushing the two parts firmly together and pull tight.

4.4 There is a light on your lifejacket. This will activate automatically if you have to enter the water.

4.5 There is a whistle for attracting attention in a pocket at the front.

#### 5. INSTRUCTIONS FOR ADONIA, AURORA, CARIBBEAN PRINCESS, CORAL PRINCESS, DAWN PRINCESS, DIAMOND PRINCESS, GOLDEN PRINCESS, GRAND PRINCESS, ISLAND PRINCESS, OCEANA, ORIANA, PACIFIC PRINCESS, PACIFIC SKY, SAPPHIRE PRINCESS, STAR PRINCESS, TAHITIAN PRINCESS AND OCEAN VILLAGE.

5.1 Take the lifejacket in both hands and place it over your head with the large section at the front. Connect the Velcro strips.

5.2 Pass the belt around your waist and connect the buckle by pushing the two parts firmly together.

5.3 Pull the belt as tight as possible while holding on to the right hand pad.

5.4 There is a light on your lifejacket. This will activate automatically if you have to enter the water.

5.5 There is a whistle for attracting attention in a pocket on the side.

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MAIB Safety Bulletin 1/2006





**MAIB SAFETY BULLETIN 1/2006**

Fire on board the Bermuda registered cruise ship

*Star Princess*

on 23 March 2006

Issued April 2006

## MAIB SAFETY BULLETIN 1/2006

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of information available to date.

*The Merchant Shipping (Accident Reporting and Investigation) Regulations 2005* provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

The Marine Accident Investigation Branch (MAIB) is carrying out an investigation into the fire on board the Bermuda registered cruise ship *Star Princess* on 23 March 2006. The MAIB will publish a full report on completion of the investigation.

A handwritten signature in black ink, appearing to read 'Stephen Meyer', with a stylized flourish at the end.

Stephen Meyer  
Chief Inspector of Marine Accidents

**This bulletin is also available on our website: <http://www.maib.gov.uk>**

**Press Enquiries: 020 7944 3232/3387; out of hours: 020 7944 4292**

**Public Enquiries: 020 7944 3000**

**INTERNET ADDRESS FOR DFT PRESS NOTICES:**

**<http://www.dft.gov.uk>**



## BACKGROUND

At 0309 (UTC+5) on 23 March 2006, a fire was detected on board the cruise ship *Star Princess*. The ship was on passage from Grand Cayman to Montego Bay, Jamaica, with 2690 passengers and 1123 crew on board. The fire is being investigated by the Marine Accident Investigation Branch (MAIB) on behalf of the Bermuda Maritime Administration, in cooperation with the United States Coast Guard (USCG), and the United States' National Transportation Safety Board (NTSB).

The cause of the fire has yet to be determined. However, the seat of the fire was on an external stateroom balcony sited on deck 10 on the vessel's port side. The fire spread rapidly along adjacent balconies, and within 10 minutes had spread up to decks 11 & 12 and onto stateroom balconies in two adjacent fire zones. It also spread internally as the heat of the fire shattered the glass in stateroom balcony doors, but was contained by the fixed fire-smothering system fitted in each of the staterooms. As the fire progressed, large amounts of dense black smoke were generated from the combustible materials on the balconies, and the polycarbonate balcony partitions. This smoke entered the adjacent staterooms and alleyways, and hampered the evacuation of the passengers. One passenger died as a result of smoke inhalation, and 13 others were treated for the effects of the smoke.

The fire was extinguished about 1.5 hours after it had started. The crew fought the fire with water hoses from adjacent external areas, and from internal alleyways. Difficulty was experienced in reaching the fire due to the construction and partitioning of the balcony areas. A total of 79 cabins were condemned after the fire, and a further 204 were either water or smoke damaged. The damaged area covered 3 vertical fire zones on 5 decks (**Figures 1, 2 and 3**).



Figure 1



Figure 2



Figure 3



## ANALYSIS

Following the accident, it has been determined by practical tests that the materials at the seat of the fire were readily ignitable, and that the polycarbonate balcony divisions generated intense heat and copious amounts of dense black smoke as they burned (**Figure 4**).

The International Convention for the Safety of Life at Sea (SOLAS) is an internationally agreed convention governing the construction and safety of vessels at sea. SOLAS regulations, as included in Chapter II-2 *Construction-Fire protection, fire detection and fire extinction*, do not, currently, prescribe the combustibility of materials used on external balcony areas, as these are not included within the vessel's fire zones. Similarly, balcony areas on cruise ships are not required to have fixed fire detection or suppression systems, as would be the case in internal areas. Additionally, balcony areas are frequently difficult to monitor due to their inaccessibility. This accident clearly demonstrates the risk of a serious fire starting and quickly spreading in areas not covered by regulation.

The installation of balconies, similar to those on board *Star Princess*, has become increasingly common in modern passenger vessels. It is vital to ensure that the fire protection arrangements within a ship, such as zoning, are not undermined by lack of appropriate measures externally. Immediate action is therefore required internationally, to address the risk of fire in external areas such as balconies, and to stop the potentially catastrophic spread of any such fire.



Figure 4

## ACTIONS TAKEN

The International Council of Cruise Lines (ICCL) has issued a safety notice (**Annex A**) to its members and other associations, identifying:

- a. Immediate actions to mitigate the risk until the medium term measures have been completed; and
- b. Additional actions to be undertaken within 3 months and 6 months, to provide longer term solutions in existing ships.

## RECOMMENDATIONS

The Maritime Administration of the United Kingdom is recommended to:

**2006/162** Submit a formal request to the forthcoming eighty-first session of the Maritime Safety Committee (MSC 81) of the International Maritime Organization (IMO) to:

- consider the issue comprehensively, with a view to urgently developing appropriate amendments to the 1974 SOLAS Convention, to address hazardous external areas of passenger ships, such as balconies, and ensure that they meet appropriate standards of fire protection, such as those currently applicable to internal areas of passenger ships;
- in the interim, issue appropriate urgent guidance on fire protection of external areas of passenger ships, such as balconies.

Cruise lines and operators/managers of passenger vessels are recommended to:

**2006/163** Take urgent action to comply with the measures identified in the ICCL Safety Notice attached at Annex A.

Flag States are recommended to:

**2006/164** Urgently review the fire safety integrity of external areas of passenger ships on their Register, to ensure that the immediate and medium-term actions taken in the light of this Safety Bulletin are effective.



INTERNATIONAL COUNCIL  
OF CRUISE LINES

April 13, 2006

## **SAFETY NOTICE**

The purpose of this safety notice is to inform ICCL members and, to the extent feasible, other passenger vessel operators, of some of the preliminary indications from the recent balcony fire on the cruise ship STAR PRINCESS. Additionally, this safety notice also urges immediate action.

The investigation, being conducted by the UK's Marine Accident Investigation Branch (MAIB) (at the request of the government of Bermuda, the flag state of STAR PRINCESS) also includes representatives of the United States Coast Guard (USCG), the United States National Transportation Safety Board (US NTSB). The purpose of the investigation is to determine the cause of the fire. A full report from the MAIB will be available at a later date.

Early indications are that the fire originated on an exterior balcony and quickly spread to other balconies in three main vertical fire zones. The cause of the fire spread is unknown at this time, but the presence of combustible material in the balcony areas is considered to have been a major factor.

This notice is to alert ship owners and ship managers of the potential fire risk on external areas, particularly balcony areas, arising from the use of combustible materials. Such areas typically lack smoke/heat detectors, and difficulty of access potentially makes fire fighting in these areas problematic. These issues combine to raise the risk of high intensity fire spreading rapidly.

In the interim, having met with the investigative authorities concerned, ICCL offers the following safety guidance to the cruise line industry:

2111 Wilson Boulevard • 8<sup>th</sup> Floor • Arlington, Virginia 22201 (USA)  
TEL (703) 522-8463 • FAX (703) 533-3811 • WEB [www.iccl.org](http://www.iccl.org)

## **Immediate Action**

1. Immediately implement measures to counter the risk of this type of marine casualty such as:
  - a. Increase vigilance on all vessels with balconies where there may be a presence of combustible materials and the lack of detectors or sprinkler systems. In this respect, the provision of dedicated lookouts and additional fire patrols should be considered.
  - b. Review the crew's onboard training and response procedures to ensure that the ship's firefighting teams are prepared to respond to a fire occurring in the balcony area.
  - c. Advise passengers and crew not to leave towels and personal belongings on balconies when they are not in their rooms.
  - d. Instruct housekeeping staff to place personal articles left on balconies by room occupants back in the room during their last visit of the day to the guest room, and to observe balconies during other visits to the room.
  - e. Re-emphasize fire safety in communications to passengers, including the distribution of appropriate informational pamphlets.
  - f. Re-emphasize to passengers the need not to throw any items over a ship's side from balconies or other external areas...
  - g. Re-emphasize to passengers the hazards of not properly extinguishing smoking materials where smoking is authorized, and never to leave smoking materials unattended.
  - h. Re-emphasize to crew and passengers the hazards of using unauthorized heating elements such as electrical heating coils used in cups or mugs and open flames such as candles.

## **Additional Actions**

2. Within three months, determine the areas at risk by carrying out a fire risk assessment of external areas, particularly balcony areas. During this assessment the following shall be taken into account:
  - Accessibility for fire fighting
  - Availability of fixed detection and fire fighting systems
  - Structural materials (particularly balcony partitions)
  - Chairs, tables and other furniture including any cushions or coverings
  - Paints
  - Deck or floor mats
  - Deck coverings
  - Handrails
  - Other combustible materials typically present, if any.
3. In accordance with the results of the fire risk assessment, and in consultation with regulatory authorities replace all inappropriate materials on balcony areas with materials that are determined to be acceptable. Replace all

combustible balcony dividers on a priority basis and as soon as possible with dividers that are of non-combustible material.

4. A plan to make any replacements of materials should be developed as a final step of the fire risk assessment, with the aim of completing this action within six months from the issue of this safety notice.

ICCL will follow-up with member lines regarding their progress.

ICCL and member lines will continue to work closely with the investigating authorities to review lessons learned from this incident and to take additional actions as appropriate.



MSC.1/Circ.1187 – Interim Operational Recommendations  
for Passenger Ships with Cabin Balconies



IMO

*E*

Ref. T4/4.01

MSC.1/Circ.1187  
23 May 2006

## INTERIM OPERATIONAL RECOMMENDATIONS FOR PASSENGER SHIPS WITH CABIN BALCONIES

1 The Maritime Safety Committee, at its eighty-first session (10 to 19 May 2006), taking into account the information available to date from the ongoing casualty investigation of the very serious cabin balcony fire onboard the passenger ship **Star Princess**, agreed that appropriate recommendations should be developed, on an interim basis, for the passenger ship industry regarding the hazards posed by cabin balconies where there may be a presence of combustible materials and an effective fire detection system or fire suppression system is not installed.

2 Therefore, in order to counter any fire risks associated with these balconies, the Committee agreed to the following recommendations for consideration with a view to implementation by the passenger ship industry:

- .1 increased vigilance such as the deployment of lookouts, fire patrols and television surveillance systems should be enhanced;
- .2 onboard training and response procedures for crew should be reviewed to ensure that the ship's fire-fighting teams are prepared to respond to a fire occurring in these balcony areas;
- .3 passengers and crew should be advised not to leave towels and personal belongings on balconies when they are not in their cabins;
- .4 housekeeping staff should be instructed to place personal articles left on balconies by cabin occupants back in the cabin during their last visit of the day to the guest cabin and to observe balconies during other visits to the cabin;
- .5 fire safety should be re-emphasized in communications to passengers and crew, including the distribution of appropriate informational pamphlets or other alternative media;
- .6 passengers and crew should be reminded of the hazards associated with throwing any items over a ship's side from balconies or other external areas;
- .7 passengers and crew should be reminded of the hazards of not properly extinguishing smoking materials where smoking is authorized and never to leave lit or smoldering smoking materials unattended; and
- .8 passengers and crew should be reminded of the hazards associated with the use of unauthorized heating elements such as electrical heating coils used in cups or mugs and open flames such as candles.

3 Member Governments and international organizations are invited to bring the above recommendations to the attention of passenger ship owners, operators and other parties concerned.



**Draft Amendments to SOLAS Chapter II-2 and the FSS Code**

## ANNEX 12

### DRAFT AMENDMENTS TO SOLAS CHAPTER II-2 AND THE FSS CODE

#### DRAFT AMENDMENTS TO SOLAS CHAPTER II-2

##### CHAPTER II-2

#### CONSTRUCTION – FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION

##### **Regulation 4 - Probability of ignition**

1 In paragraph 4.4, the words “and cabin balconies on passenger ships” are added between the words “stations” and “shall”.

##### **Regulation 5 - Fire growth potential**

2 In the second sentence of paragraph 3.1.2.1, the words “including cabin balconies” are added between the words “space” and “for” and the following new sentence is added at the end of the paragraph:

“Cabin balconies on passenger ship constructed before [1 July 2008] shall comply with the provisions of this paragraph by the first survey after [1 July 2008].”

3 In the first sentence of paragraph 3.2.1.1, the words “and cabin balconies” are added between the words “spaces” and “which” and the following new sentence is added at the end of the paragraph:

“In addition, the provisions of paragraph 3.2.3 need not be applied to cabin balconies.”

4 The following new subparagraph is added to the existing paragraph 3.2.4.1:

“.3 exposed surfaces of cabin balconies, except for natural hard wood decking systems.”

5 The following new paragraph is added after the existing paragraph 3.3:

“3.4 *Furniture and furnishings on cabin balconies of passenger ships*

Furniture and furnishings on cabin balconies shall be of restricted fire risk, as defined in regulation 3.40, unless such spaces are protected by a fixed pressure water-spraying system and fixed fire detection and fire alarm system approved by the Administration complying with regulations 7.10 and 10.6.1.3. Passenger ships constructed before [1 July 2008] shall comply with the provisions of this paragraph by the first survey after [1 July 2008].”

### **Regulation 6 - Smoke generation potential and toxicity**

6 In paragraph 2, the words “and exposed surfaces of cabin balconies on passenger ships, except for hard wood decking systems on cabin balconies,” are added between the words “surfaces” and “shall”.

7 In paragraph 3, the words “and on cabin balconies of passenger ships,” are added between the words “stations” and “shall”.

### **Regulation 7 - Detection and alarm**

8 The following new paragraph 10 is added after the existing paragraph 9.4:

#### **“10 Protection of cabin balconies on passenger ships**

A fixed fire detection and fire alarm system shall be provided for cabin balconies where the furniture and furnishings for such balconies are not of restricted fire risk.”

### **Regulation 10 - Fire-fighting**

9 The following new paragraph 6.1.3 is added after the existing paragraph 6.1.2:

“6.1.3 Passenger ships shall be equipped with a fixed pressure water-spraying fire-extinguishing system of an approved type complying with the requirements of the Fire Safety Systems Code for cabin balconies where furniture and furnishings are not of restricted fire risk.”

10 The following new paragraph 11 is added after the existing paragraph 10.3.2:

#### **“11 Partitions separating cabin balconies**

Partitions not forming part of the ship’s structure and separating cabin balconies shall be capable of being opened by the crew from each side for fire-fighting purposes.”

**DRAFT AMENDMENTS TO THE FSS CODE**

**CHAPTER 7**  
**FIXED PRESSURE WATER-SPRAYING AND WATER-MIST**  
**FIRE-EXTINGUISHING SYSTEMS**

- 1 The following new paragraph 2.3 is added after the existing paragraph 2.2:

**“2.3** *Fixed pressure water-spraying fire-extinguishing systems for cabin balconies*

Fixed pressure water-spraying fire-extinguishing systems for cabin balconies shall be approved by the Administration based on the guidelines developed by the Organization.\*”

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\* Refer to the guidelines to be developed by the Organization.

**CHAPTER 9**  
**FIXED FIRE DETECTION AND FIRE ALARM SYSTEMS**

- 2 The following new paragraph 2.3.1.6 is added after the existing paragraph 2.3.1.5:

**“2.3.1.6** Fixed fire detection and fire alarm systems for cabin balconies shall be approved by the Administration based on the guidelines developed by the Organization.\*”

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\* Refer to the guidelines to be developed by the Organization.

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