Reliability of SAR action elements

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Main elements in SAR action:

HRA - human reliability assessment

Rescue unit - reliability of the rescue vessel assigned to SAR action

Search object - reliability of life raft, a searched for object
Main elements in SAR action:

**HRA** - human reliability assessment

**Coordinator** - reliability of SAR action coordinator

**Ship master** - reliability of ship master and crew (experience, knowledge etc)
Main elements in SAR action:

Rescue unit - reliability of the ship(s) assigned to SAR action
Main elements in SAR action:

Search object
- reliability of life raft

PIW
- water temperature

Fig. 1. The survival probability of object in water, \( Sp(t) \), in function of time, at 20°C water temperature

\[
Sp(t) = e^{-0.1654t^{1.3213}e^{-0.071tw}}
\]

Time counted from the instant of accident occurrence, i.e. ship abandonment/the instant of reaching site of action.

Main elements in SAR action:

Search object - reliability of life raft, a searched for object

Life raft

- unreliability
- reliability
Main elements in SAR action:

Search object - reliability of life raft

Figure 2: Forces acting on a life raft under the wind.

Main elements in SAR action:

Search object - reliability of life raft

Figure 3: Research on a 10 person life raft drug carried out in the towing tank and research on aerodynamic reactions force in the wind tunnel

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Main elements in SAR action:

Search object - reliability of life raft

Figure 4: A graph of leeway for a 6-person life raft occupied by 1 and 6 persons, a 10-person life raft occupied by 1 and 10 persons, a 20-person life raft occupied by 2 and 20 persons, without a drogue

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Figure 5: A graph of leeway for a 6-person life raft occupied by 1 and 6 persons, a 10-person life raft occupied by 1 and 10 persons, a 20-person life raft occupied by 2 and 20 persons with drogue
Main elements in SAR action:

Search object - reliability of life raft

Figure 6: Total drag and trim in the downwind for a 20-person life raft: A - occupied with 2 persons, B - occupied with 10 persons, C - occupied with 20 persons, D – life raft with a drogue

Main elements in SAR action:

Search object - reliability of life raft

The information of the reliability of life saving appliances is essential during a search and rescue action however, there are no available methods allowing determining of life saving appliances failure in heavy weather.

The first attempt was made to determine the life raft safety using the random variable of “limit wind velocity”.

The reliability function for the life raft was developed on the basis of the results of experimental research on hydrodynamic and aerodynamic reaction forces for 6, 10 and 20 person life rafts with and without a drogue.

Main elements in SAR action:

Search object - reliability of life raft

The function:

$$R(x) = P(Z_{tr} > x) = 1 - \int_0^x f_Z(z)dz = 1 - \frac{\lambda_1^{\alpha_1} \lambda_2^{\alpha_2}}{\Gamma(\alpha_1, \alpha_2) B(\alpha_1, \alpha_2)} \int_0^x \frac{z^{\alpha_2-1}}{(\frac{\lambda_1}{3} + \frac{\lambda_2}{2} z)^{\alpha_1+\alpha_2}} dz \quad z > 0$$

is the safety function of the life raft.

- $R(x)$ – life raft reliability, safety function
- $Z_{tr}$ – maximum value of life raft speed (wind leeway),
- $x$ – wind velocity,
- $y$ – speed of life raft expressed numerically,
- $a, b$ – mean values of the independent non-negative random variables $A, B$
- $A$ – random variable of the gamma distribution
- $B$ – random variable of the gamma distribution

Main elements in SAR action:

Search object - reliability of life raft

Table: Values of reliability function for 6, 10 and 20 person life rafts without drogue

<table>
<thead>
<tr>
<th>Wind speed $x$ [knots]</th>
<th>Life raft 6-1</th>
<th>Life raft 6-6</th>
<th>Life raft 10-1</th>
<th>Life raft 10-10</th>
<th>Life raft 20-2</th>
<th>Life raft 20-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R(x)$</td>
<td>0.3895</td>
<td>0.9474</td>
<td>0.8774</td>
<td>0.9673</td>
<td>0.0170</td>
<td>0.0611</td>
</tr>
</tbody>
</table>

The safety function of the life raft decreases with the increase of wind velocity and is depended on life raft dimensions and occupation by survivors.

Thank you