General

This paper contains the German comments on the input of other participants of the SDC2 CG on Evacuation Analyses.

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Round: 4

1 TOR 1

1.1 General

1.1.1 FSS Code Chapter 13, 2.1.2.2.2.1 Case 2 (Germany)

Germany will submit this in a different paper to SDC3, among other details.

1.2 CESA

1.2.1 Restructuring of the guideline, Documentation of crossing/counter flows

CESAs comment regarding the percentage of crew helping with the evacuation goes into the same direction as 1.3.2. Proposing a concrete value would be very much appreciated.

CESAs comment to tolerate areas of crossing and counter flows as long as the total evacuation duration remains within the set limits is supported.

1.3 CLIA

1.3.1 Restructuring of the guideline

We think it is best, if a native speaker would clarify the points made. It may have gone wrong in some cases due to copy/paste errors.

1.3.2 Restructuring of the guideline, Documentation of crossing/counter flows

CLIA pointed out, that crew members would be activated earlier to the passengers and thus avoid crossing or counter flows. The circular takes helping crew into account by not adding them to the population. Maybe the percentage should be increased to a more realistic level. We propose, that CLIA submits a more realistic percentage value for crew helping with the evacuation.

1.3.3 Exchange of passengers between assembly stations

We are not persisting on additional simulations, however we think it is important to document the information, that an assembly station may get overcrowded. Especially in case of RoPax ferries, this may be relevant.

1.4 Netherlands

1.4.1 Exchange of passengers between assembly stations

See 1.3.3.

1.5 UK

1.5.1 Response time distributions

Germany still prefers a narrow distributed response time distribution and has the following comments on the submission of the UK:

UK: We feel it must be recalled that the previous version of MSC Circ. 1238 i.e. MSC Circ. 1033 had an arbitrary unrepresentative definition of the passenger response time distribution.

The distributions of Circ.1033 were derived from the first circular dealing with evacuation analyses, Circ.909. It was based on the submissions of Italy and it can be assumed, that the original response times were based on scientific evaluations in the building industry, e.g. by Prof. David Purser. It has been a long time ago, but maybe Italy can clarify.

UK: The proposal from Finland and Germany would lead, in the view of the UK, to another arbitrary unrepresentative response time distribution and this is in our view a backward step from the status quo.

This is a question of the philosophy Circ.1238 should follow: Trying to be as realistic as possible or to be as practical as possible while still creating useful results. From Germanys viewpoint, the limitations of an analysis like the one discussed should clearly be kept in mind. The variety of real influences causing an evacuation is almost endless (fires in every possible location, flooding, heel, capsizing…), and as soon as a certain scenario claiming to be realistic is introduced, other possible scenarios are excluded.

This is why Germany sees Circ.1238 as a theoretical method to investigate an evacuation concept. Following, it should be the goal, to investigate the efficiency of the system und the biggest pressure possible. This is the case, when all people react within a relatively short period, so the amount of persons in the corridors is largest. It has shown, that increasing the spread of the response time distribution only reduces the size and amount of congestions.

Following, results of a typical, modern cruise vessel are shown, the red areas in the density plots showing significant congestions according to the definition of Circ.1238:

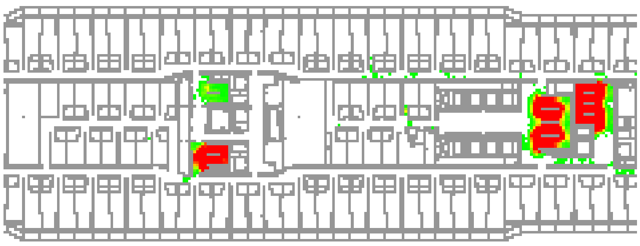
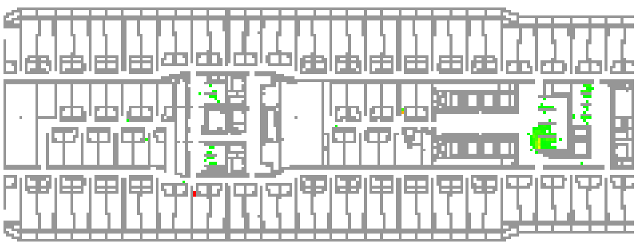
Density Plots according Circ.1238	**Distribution**
	IMO Night
	UK proposal
	400 – 550 s

Fig. 1: Significant congestions (red) depending on the response duration distribution.

The density plots show, that significant congestions usually appearing on the stair cases (being the classic bottlenecks) disappear, when spread of the response duration distribution is increased, since less persons walk through the egress routes at the same time.

UK: For example, the uniform random response time distribution used in MSC Circ 1033 led to the formation of congestion regions that did not exist when a more realistic response time distribution was used and missed congestion regions (and the severity of congestion regions) that occurred when a more realistic response time distribution was used.

This does not match the experiences of our experts or the results shown above.

Another point of concern arises, regarding the proposed distributions and their effect on the overall result: For type 2 vessels, the distribution span is increased from 400-700 to 400-1100. This again rises the question of which philosophy we would like to follow with the circular. Pursuing the goal of realism, we would have to assume, that a certain percentage of passengers will just not react to the evacuation signal in a given time as accidents have shown. However, this would require a cut off for the travel duration of e.g. 95% of the passengers having reached their assembly station. As discussed earlier (in FP committee), this is not feasible for an official guideline.

With the response duration distributions proposed by the UK, the response time of the last person to react is increased by 400 s, having the significant result shown in the following table for the vessel shown above:

Distribution	**IMO night**	**UK proposal**	**400-550 s**
Sign. Duration	23:20 min	27:18 min	23:40
% increase	0	+17%	+1%

Tab. 1: Significant travel durations depending on the response duration distribution.

The response duration distribution as proposed by the UK would in this case lead to an increase of the significant travel duration by 17%. Decreasing the response duration spread has also increased the travel duration by 1%. This may be due to the increase of congestions. We are not sure, whether all vessels would still fulfil the time criterion with such a significant increase of travel duration due to the new response duration distribution submitted by the UK.

UK: The night case distribution for Type 2, in keeping with the approach IMO uses to represent the night case RTD used in MSC Circ. 1238, has been shifted by 400s to the right to account for the fact that passengers would be sleeping (which is typically not the case for the trials conducted).

The only trial for a cruise ship was conducted at 9:00 in the morning, so it did not comprise a realistic night case with all passengers asleep in their cabins. We see the point, that it will be difficult to persuade an owner to perform an appropriate test (at 2:00 during the night?). All data was collected from the cabion areas and in order to account for sleeping passengers, the earlier called arbitrary 400 s offset was added.

The RoPax vessel used for trials did not have any passenger cabins and both trials were conducted in the morning at around 8:20. Again this does not represent a night case, so the argument, that the night response duration distribution of RoPax and cruise vessels significantly differs seems to lack evidence.

This is what we meant with “questionable” results.

Maybe it would be wise, to orientate the distributions according to the response duration distributions gathered by Prof. David Purser. For a hotel with an optimal alarm system, he proposes 300-900 s.

UK: *…this data represents 633 unique response time data points…*

Although this number seems to be large, it only represents the response durations of 633 persons in one scenario. Compared to 4000 passengers on board of a modern cruise ship, this number is small and since it only covers one scenario (=one test), the resulting distribution may be a start, but it is not statistically sound.

UK: *As is evidenced by the data, the passenger response behaviour is quite different on cruise ships and ro-pax vessels.*

Please clarify. Is there any explanation why this difference could occur? We have to point out, that there are also RoPax ferries without deck passages, so eventually, all passengers will be in a cabin at night.

FRANCE: The influence on the simplified method is not documented**.**

UK REPLY: The simplified approach is not mentioned as it currently does not utilise the log normal response time distribution, even within the existing MSC Circ 1238. Within the simplified analysis, currently the Awareness time (A) is arbitrarily given the value 10 min for the night time scenarios and 5 min for the day time scenarios. These values are completely arbitrary and without engineering justification. It is suggested that the same process of selecting these values should be used for the new distributions.

As argued above, it is possible, that the original data was based on data provided by Prof. David Purser.

1.5.2 Software test

UK: If software is to be used to predict evacuation dynamics it must be able to provide a reasonable prediction of test cases based on realistic situations.

Past cases have shown, if a validation case like this is introduced, it will be in the interest of software developers to generate a result, which is as close to this scenario as possible. It is an easy task to distribute the demographic parameters (response duration, walking speed…) to generate almost the exact same result as the test case. So the general outcome of this comparison will be, that it is possible to define the input data in a way, so a given result is reached. This is deterministic.

However, when performing an advanced evacuation analysis, the basis is a statistical analysis. Since many variables are unclear, they are defined by statistical distributions and the evaluation of many simulation runs with all parameters stochastically chosen according to the given statistics will allow for a statistical sound evaluation.

Since it is not known, how “good” or “bad” the real trial was, the only qualitative result of comparing it to a statistical analysis would be, if the test result lies somewhere between the fastest and the slowest evacuation simulation.

2 TOR 2

No comments.

3 TOR 3

3.1 General

3.1.1 Scenario Definition

Please see our proposal for case 5 in the restructured circular.

4 TOR 4

4.1 General

4.1.1 Simulation of embarkation duration

Proposal: *An analysis of travel time from assembly station to embarkation deck should be conducted in order to determine embarkation duration E. All persons which the ship is certified to carry are initially distributed according to the designated capacities of the assembly stations. The persons will move to the embarkation deck according to the procedures and designated routes.*

It should not be “to embarkation deck” but “to the entry point of the LSA”. The rate at which persons will then leave the ship into the LSA is clearly defined by the approval tests performed for the LSA.

4.1.2 “Scenarios addressing loss of one MVZ” and “Secondary cases for each MVZ”

Our proposal in round 1 should cover both scenarios.

4.2 UK

4.2.1 Heel/Trim

As other countries pointed out, we still are not convinced about adding heel and trim. This once again comes down to the general philosophy, the circular is supposed to follow (realism, theory). In Germanys opinion, it should not try to cover all eventualities, the Common Assumptions of the guideline pointing out exactly this point.

A master thesis in Germany came to the conclusion, that no real additional information regarding the evacuation concept is gathered, when implementing heel and trim. It is available for download:

http://www.traffgo-ht.com/downloads/research/studies/Schuler2014.pdf

Additionally, the angles are to extreme, for a trim of 10° would mean, that the bridge of a cruise ship would already have touched the sea. An evacuation would have been issued long before.

4.2.2 Congestion Criterion

UK: *The first part is that the congestion criterion becomes a pass/fail criterion. The German comments do not address this point.*

Germany is of the opinion, that congestions do occur and it should be the objective of the crew to deal with them, so the situation will not deteriorate. An evacuation without congestions would require extremely large stair cases which is unrealistic, so we do not support the congestion criterion to be a pass/fail criterion.

For the vessel shown in Fig. 1, the new congestion criterion referencing the allowable travel duration would result in all congestions disappearing. This gives a wrong impression of what the crew has to expect. In the given example, the information to increase the use of the aft port stair case whioch is not congested would be vital for the crew.

UK: *If one vessel has a long but acceptable assembly time and a second vessel has a shorter assembly time, using the current guidelines, the vessel with the shorter assembly time is disadvantaged compared to the vessel with the longer assembly time as it cannot experience the critical level of congestion for as long as the vessel with the longer assembly time.*

Since congestions are not a pass/fail criterion, no vessel will be disadvantaged. The information retrieved according to the current definition will always allow the designer to find the bottlenecks which allow for improvements.

4.2.3 Increase minimum number of simulation runs

UK: *The German suggestion is to increase arbitrarily the number of simulation runs from the current 50 to 500. We agree with the French position that this is arbitrary and not justified.*

The proposed amount of 500 is indeed arbitrary and only based on experiences gained. However, it is hard to determine, if all relevant possibilities are covered by the proposal made. Fig. 2 shows once again the duration distribution for an embarkation analysis for 500 simulation runs with the green column representing the significant duration. There is no guarantee, that the cases leading to very large durations (spikes beyond 2100 s) are covered by the proposed criterion.

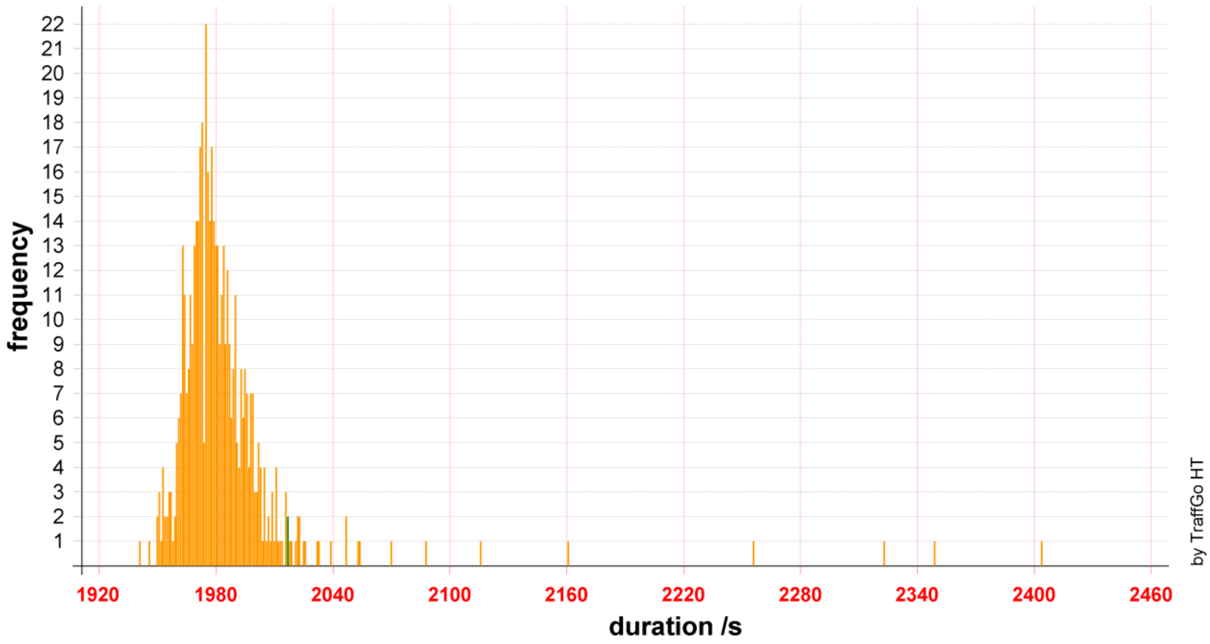


Fig. 2: Duration distribution for an embarkation scenario.

Following, the Scenario was analysed for ~2.500 simulation runs and the results were evaluated in different ways (see Fig. 3).

The convergence criterion proposed by the UK was met within the first 50 runs. At this time, none of the events leading to long durations have occurred. Later on, at around 422 runs, the 5% criterion was suddenly exceeded, so it seems, like this criterion does not lead to a convergence.

Subtracting the max and minimum value showed some kind of convergence and calculating the variance of the results as well, but setting a criterion seems to be a bit arbitrary.

The purple curve shows the per mill, the 95percentile is changing with every additional run. After strong fluctuations in the beginning, the value does not change for 50 runs after 368 simulations, however, these 50 runs are once again arbitrary.

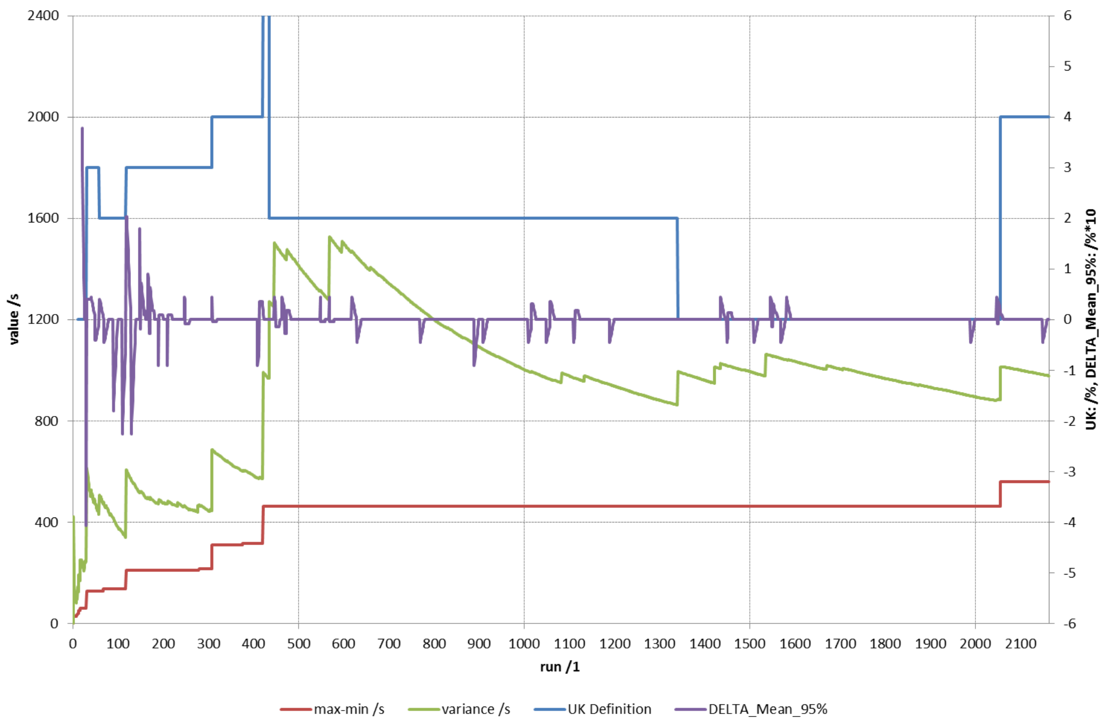


Fig. 3: Ways of statistical evaluations.

Germany proposes to postpone a decision concerning a convergence criterion until SDC3, so more time is gained in finding one.