

## Standards & Related Documents Committee

### TECHNICAL BULLETIN - OCTOBER 1999

#### 195. Controller's Design Maturity Risk Assessments

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Paragraph 15 of HSG175<sup>1</sup> says :-

“Reports of design review may not be available or needed for older attractions whose design has been proved by maturity. Whether a design review is needed or not depends on the controller's assessment of risk aided by advice from an inspection body.”

This technical bulletin discusses the risk assessment method of demonstrating design safety mentioned in the second of the two quoted sentences above.

It became clear, during the preparation of HSG 175, that many existing amusement devices had never had a proper design review. There are three groups of equipment in this situation that may be able to take advantage of the design maturity risk assessment route for some or all of its hazards :-

- equipment that was in use in Great Britain prior to 1984, when design review was first introduced into *A code of safe practice at fairs* (paragraph 80); or
- equipment brought into use in Great Britain between 1984 and October 1997 which did not comply with the recommendation for Design Review in HSE publications (i.e. *A code of safe practice at fairs* and *Fairgrounds and amusement parks: A code of safe practice*, HS(G)81); or
- any device brought into use in Great Britain before October 1997 which had a Design Review which did not cover all safety-related disciplines (e.g. covering mechanical / structural but not electrical).

It should be noted that amusement devices imported into Great Britain after October 1997 cannot be considered under the design maturity risk assessment procedure but must undergo a Design Review carried out by an Inspection Body registered for design review work, irrespective of the age of the device. This is made clear in Section C of HSG 175.

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<sup>1</sup> *Fairgrounds and Amusement Parks - Guidance on Safe Practice* (HSG 175; HSE Books; ISBN 0 7176 1174 4)

Section C of HSG175 also makes clear that the controller's design maturity risk assessment procedure is not relevant to British-built amusement devices brought into use in Great Britain after October 1997. The guidance requires that such equipment should have proper Design Review by an appropriately registered Inspection Body. We have heard of instances where design review has not been carried out because, although the ride was new, the "design" was mature. We cannot find any references in HSG175 from which this dispensation might be inferred, and it was certainly not the intention of the JAC members when the guidance was written.

It is important to be aware that a risk assessment of design safety is distinct from the normal simple operational risk assessment carried out by the controller. The hazards to be considered are those which might be associated with design shortcomings, and the normal mathematical, scientific and engineering tools are required for the assessment of the probability of harm.

In new equipment some risks would be shown to be within the tolerable range by calculation or test. The principle underlying the concept of maturity of older equipment is that, even though the original calculations or tests were never carried out (or, if they were, they were never independently checked), the passage of time may have demonstrated that some risks are at a tolerable level.

However, in order to be able to argue maturity in relation to specific components, reliable information is still required. For instance, evidence of the following might be available :-

- accident / incident history
- records of the replacement of safety critical components as a result of wear or fatigue;
- inspection reports;
- daily checksheets;
- manufacturer's technical / service bulletins;
- other items in the Operations Manual;
- Health and Safety Executive information sheets;
- NAFLIC Technical Bulletins.

In order to be able to make use of some of this evidence it is, of course, important to be certain that any safety critical component under consideration is as old as the ride or of known minimum age.

As an example of the type of argument that it may be possible to apply, in some circumstances, consider fatigue cracking. Suppose that the age of a specific component is known and that a particular stress raiser on it has not had to be replaced or repaired. Providing that a reasonable idea of the dominant stress sources is known, an estimate of the number of stress cycles experienced to date may be made. From this it is possible to decide whether the "knee" of the fatigue / life curve has been reached. If it has, then the risk assessment may conclude, without detailed calculation of the stress ranges, that future fatigue cracking at that location should not occur. If the knee of the curve has not been reached then, providing that a sufficient number of cycles has elapsed, it may be possible with an appreciation of crack propagations rates, to conclude without detailed calculation of stress

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ranges that a new crack, if it were to occur, could not develop dangerously in the period between NDT inspections.

There are, of course, other examples where the passage of time does **not** add to one's knowledge of the safety of a design feature. For instance, where random hardware failure can occur, an unsafe design could be associated with a harmful event at any time. This uniform failure rate is normally assumed to apply to electrical / electronic components for instance. For this reason, where residual risk is too high, redundant and diverse secondary systems will often be required. Unfortunately, some control system functions or secondary systems are only accessed in emergency circumstances. This means that an old amusement device may still have untested inherent faults. Maturity does not necessarily, in these circumstances, indicate safety but more that, so far, the gambler has had good luck.

The time needed to complete a controller's design maturity risk assessment may range from several hours up to possibly a period of weeks. Indeed the assessment may even demonstrate a need for either partial or full design review.