7. **Can you be more explicit on the failure frequencies used in Table 3.3: they do not appear to accord with the frequencies used in PCAG chaps 6n or 6k.**

The failure frequencies for tanks in Table 3.3 of the report are drawn from two HSE sources. The frequencies for single-walled and double containment tanks are taken from PCAG Chapter 6K, Item FR1.1.1.2. PCAG Chapter 6K contains most of the failure frequency data used by HSE Inspectors in their assessments. However, occasionally Inspectors come across items of equipment that are not covered by Chapter 6K. In such cases the Inspector then formally requests guidance on the appropriate frequencies to use from the unit failure frequency expert. The expert issues their advice in a document (in the 'FR' series) that then becomes a supplement to PCAG. This was the case with full containment tanks, where a supplementary document FR/100 was created. Hence the full containment tank failure frequencies in Table 3.3 are taken from the HSE document FR/100.

FAILURE RATE ADVICE

Requested By: Tony Williams **Request No:** FR/100

Date: 15th May 2006

Request:

I require your advice on appropriate failure frequencies for use in an LUP (consent) assessment for the Calor Gas installation, Canvey Island. I need frequencies to model failure scenarios in:

a) 2 x 120,000m^3 (83.6m dia, 46.3m high) tanks for the storage of LNG, and

b) 1 x 20,000m^3 (4m dia, 35.5m high) tank for the storage of refrigerated LPG.

All the tanks will be of a 'full containment' design to BS EN 1473 (although this standard is strictly applicable only to LNG). Obviously the frequencies for the LNG tanks are more important because releases from them are likely to dominate the off-site risk and hence our advice to the local authority.

Advice.

Scenario	Failure rate (cpm per vessel year)
Catastrophic failure	0.05
Major failure (1000 mm)	1
Minor failure (300 mm)	3
Failure with a release of vapour only	vapour contained

Basis of Advice:

FR/73 identified a potential conservatism with the failure rate values in PCAG 6K for full containment bulk LNG storage tanks. Using expert judgment the author of FR/73 derived alternative (and lower) failure rate values that were used to support the LUP advice for the proposed LNG tanks at Milford Haven. Given the importance attached to the use of cautious best estimate failure rate data for use in LUP advice and the proposed introduction of new design standards for LNG storage tanks HSL were asked to conduct a thorough review of the information available to HSE on LNG storage tank failure rates. The results of the review are contained in RAS/06/05.

One of the conclusions of the review is that HSE should consider reducing the failure rates in PCAG 6K for double walled LNG storage tanks by one order of magnitude. The review also states that the reduced values may also be appropriate for the generic failure rates of refrigerated double wall tanks. (Note that the current HSE policy is to adopt the same failure rates for full containment tanks and double walled tanks except in the case of the release of vapour only. In the case of full containment tanks the failure rate for the release of vapour only is set to zero.)

Based on the review in RAS/06/05 the following failure rates are recommended for the two large LNG tanks described in your request [item a) refers]:

Scenario	Failure rate (cpm per vessel year)
Catastrophic failure	0.05
Major failure (1000 mm)	1
Minor failure (300 mm)	3
Failure with a release of vapour only	vapour contained

The following points should be noted in connection with the use of the values above:

1. BS EN 1473 does not specify the design requirements for the storage tanks and refers to a design and manufacturing code under development in CEN/TC 265. The code in question is prEN 14620 and this was formally approved by CEN/TC 265 in April 2006 to go forward for publication. Tanks manufactured in accordance with this standard will be some of the first of their type.
2. Your request contains no information about the materials used to fabricate the inner tank and the outer containment vessel and therefore the failure rates quoted above are necessarily generic in nature (for the case considered in FR/73 the outer containment vessel was known to be manufactured from reinforced concrete).