

Introduction

UKOPA¹ is considering the preparation of guidance on the seismic design requirements for hazardous substance pipelines and installations in the United Kingdom (UK). This guidance would assist UKOPA member companies to comply with the requirements of Eurocode 8 in a consistent and proportionate manner. In developing guidance UKOPA would like to take account of current practice in EU countries with similar low seismicity to the UK. These are listed on the figure on page 3.

Context

Eurocode 8 Part 4 (EN 1998-4:2006) for the earthquake resistance design of silos, tanks and pipelines uses an importance factor for reliability differentiation according to an importance class dictated by the potential consequences of structural failure.

The importance classes and factors are as follows:

Importance Class	Potential Consequences of Structural Failure	Importance Factor γ_I
I	Risk to life is low and the economic and social consequences of failure are small or negligible.	0.8
II	Medium risk to life and local economic or social consequences of failure.	1.0
III	High risk to life and large economic and social consequences of failure.	1.2
IV	Exceptional risk to life and extreme economic and social consequences of failure.	1.6

For the no-collapse condition the importance factor is multiplied by the seismic action for the code reference return period of 475 years and this has the effect of decreasing or increasing the return period according to the importance class of the silo, tank or pipeline.

Consequence classes CC1, CC2 & CC3 are defined in EN 1990:2002 for reliability differentiation of structures. These are referred to in Eurocode 8 and in UK published guidance. EN 1998-4:2006 correlates the importance classes I, II, III & IV to the consequence classes CC1, CC2 & CC3 as follows:

Importance Class	Consequence Class	Description of Consequence Class
I	CC1	Low consequence for loss of human life, <i>and</i> economic, social or environmental consequences small or negligible
II	CC2	Medium consequence for loss of human life, economic, social or environmental consequences considerable
III&IV	CC3	High consequence for loss of human life, <i>or</i>

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		economic, social or environmental consequences very great
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UK recommended guidance in PD 6698 and in the UK National Annex to EN 1998-4:2006 is that CC3 structures should adopt a seismic action for the no-collapse condition based on a return period of 2500 years. However, a site specific hazard analysis is recommended for structures and facilities, the failure of which would have very significant regional or national consequences for the population or the environment.

The UK opinion expressed in PD 6698 is that the return periods and importance factors recommended in the main body of EN 1998 are inappropriate for an area of very low seismicity such as the UK, and are too small for the no-collapse requirement.

Queries to EPRG

- 1. Are hazardous substance pipeline and installation operators/owners in areas of Northern Europe with similar seismicity to the UK applying the recommended return periods in EN 1998-4 for seismic actions? If not, what alternatives are adopted?**
- 2. Are any categories of hazardous substance pipeline or installation considered to exceed Importance Class IV to EN 1998-4? If so, what are they?**
- 3. Is there any similar opinion in Europe that the return periods recommended in Eurocode 8 are inappropriate and too low for some categories of hazardous substance pipeline and installation in the low seismicity areas of Northern Europe? If so, can any reference to this opinion be cited?**

Documents Referred to in Text

BS EN 1998-1:2004. Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings. BSI. April 2005.

BS EN 1998-4:2006. Eurocode 8: Design of structures for earthquake resistance – Part 4: Silos, tanks and pipelines. BSI. September 2006.

NA to BS EN 1998-4:2006. UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 4: Silos, tanks and pipelines. BSI. August 2008.

PD 6698:2009. Recommendations for the design of structures for earthquake resistance to BS EN 1998. BSI. 2009.

BS EN 1990:2002. Eurocode – Basis of structural design. BSI. March 2006.

