Classification: Internal Use

UKOPA PIWG

GPG/19 Seismic screening of pipelines and installations

GPG/20 Management of pipelines subject to ground movement

A quick ‘heads up’

- ISO 19345-1:2019 – Integrity Management for Onshore Pipelines
- Standard issued on 10 May 2019
- The PIWG last saw this in January 2018 at the DIS stage (issued for comment)

- Specifies requirements and gives recommendations on the management of integrity of a pipeline system throughout its life cycle which includes design, construction, commissioning, operation, maintenance and abandonment. It is applicable to onshore pipeline systems used in transportation in the petroleum and natural gas industries, connecting wells, production plants, process plants, refineries and storage facilities, including any section of a pipeline constructed within the boundaries of such facilities for connection purposes

Screening of Assessment of Pipelines and Associated Installations – GPG 19

GPG 19

- is based on:
  - Technical study carried out by Jacobs for National Grid, provided to PIWG
  - Expert review of Jacobs technical study for PIWG
  - Consideration of Draft ISO Standard 20074 - Pipeline transportation systems – Geological hazard risk management for onshore pipelines.
- Includes a 4 step screening methodology:
  - Assignment of importance classification (according to area class and criticality)
  - Assignment of importance factor
  - Calculation of seismic action parameters (ground acceleration, soil factor)
  - Application of ground acceleration criteria (reference - PD6698 Seismic Hazard Map)

Importance Class

Safety	Economic, Social and Environmental Consequences		
	Low	Considerable	Great
Low	I	II	III
Medium	II	II	III
High	III	III	III

Notes:

Class I Refers to situations where risk to life is low, and economic, social and environmental consequences of failure are low

Class II Refers to situations with medium risk to life, and considerable economic, social or environmental consequences of failure

Class III Refers to situations with high risk to life, and great economic, social and environmental consequences of failure

Importance Factor

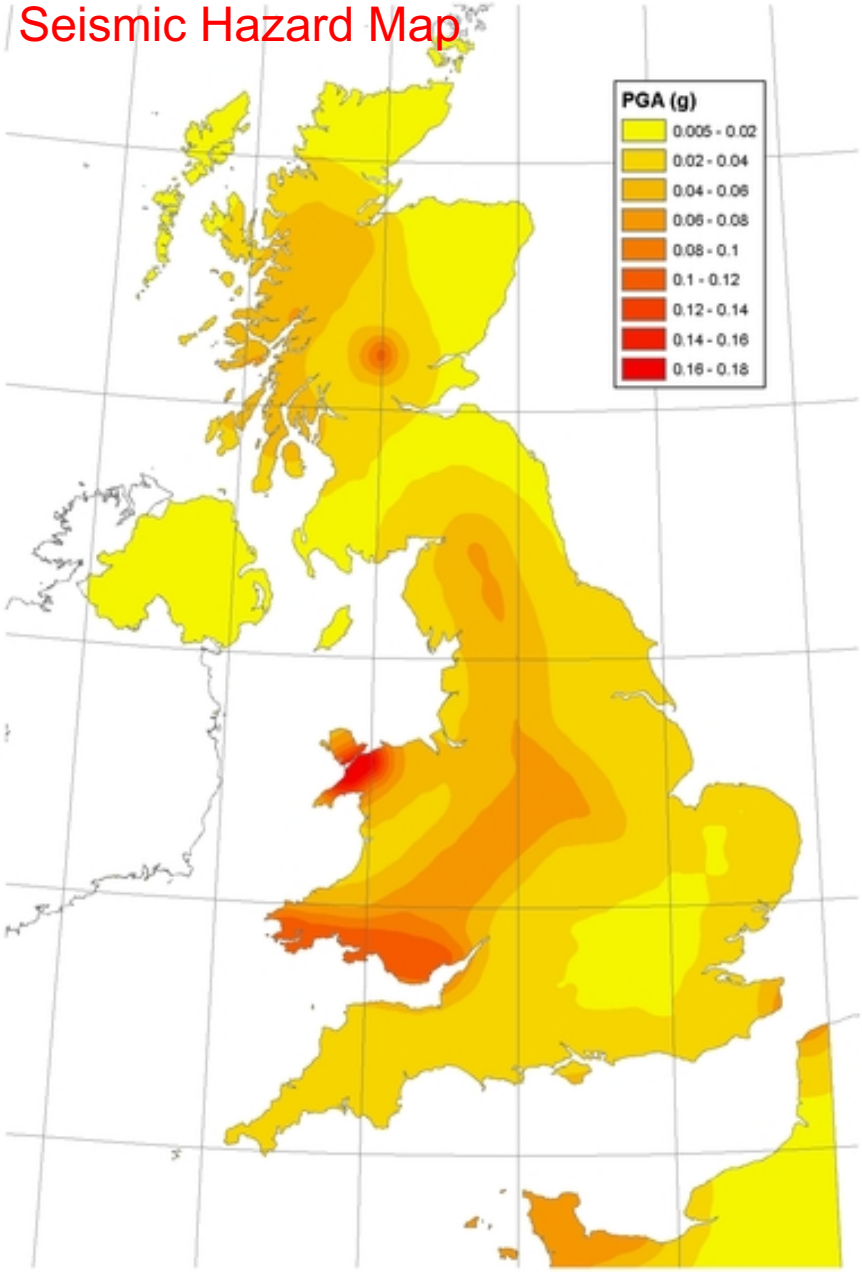
Importance Class	I	II	III
Importance Factor γ_I	n/a	0.45	1.0

Seismic parameters

Ground Type	Description	Amplification S
A	Rock	1.0
B	Very dense granular deposits or very stiff clays	1.35
C	Dense to medium dense granular deposits or stiff clays	1.5
D	Loose to medium dense granular deposits or soft to firm clays	1.8
E	Type C or D (5-20m) overlying rock	1.6

Ground Acceleration = $\gamma_I \times a_{GR} \times S$

Seismic Hazard Map

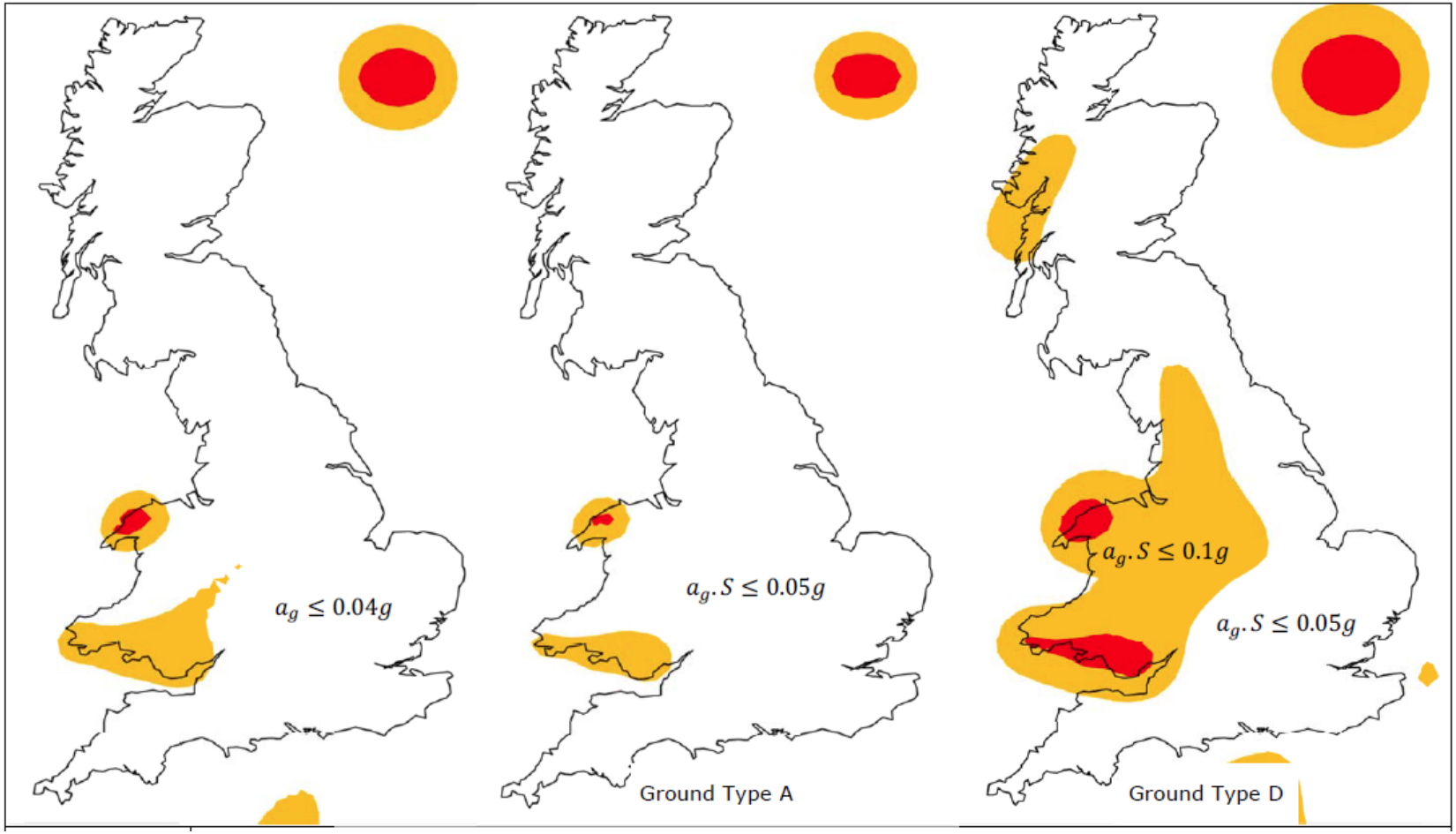


Criteria

Importance class	$a_g.S \leq 0.1\,g$		$a_g.S > 0.1\,g$	
	Buried pipelines	Above-ground installations	Buried pipelines	Above-ground installations
I	None			
II	None			Simplified
III	None	Simplified	Full	

Seismic screening criteria applied to pipelines and installations

Regions of very low (white), low (yellow) and increased (red) seismicity (EN 1998-4)



PIWG Seismic Screening Workshop

- An operator workshop was held to:
  - Assess the screening methodology for gas and liquid assets, advise on requirement for a seismic assessment procedure
  - Develop worked examples for inclusion in GPG 19

Worked examples

Importance class (IC)	Importance factor (IF) yI	PGA (Seismic hazard map) a_{Gr}	$a_g = y_I * a_{Gr}$	a_g x S		Seismic assessment	
				Soil A S = 1.0	Soil D S = 1.8	Soil A	Soil D
Gas AGI R IC = II	0.4500	0.0700	0.0315	0.0315	0.0567	None	None
Gas AGI S IC = II	0.4500	0.1500	0.0675	0.0675	0.1215	None	Simplified
Gas import terminal IC = III	1.0000	0.0300	0.0300	0.0300	0.0540	Simplified	Simplified
Gas compressor station IC = III	1.0000	0.0700	0.0700	0.0700	0.1260	Simplified	Full
Liquid pump station IC = II	0.4500	0.0500	0.0225	0.0225	0.0405	None	None
Gas pipeline IC = II	0.4500	0.1100	0.0495	0.0495	0.0891	None	None

Workshop Recommendation

- Screening procedure identified requirements for both simplified and full seismic assessments
- Seismic assessment procedure is required
- Seismic assessment procedure developed by National Grid is being revised by DNVGL for PIWG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Questions?

Management of Pipelines subject to ground movement – GPG 20

GPG 20

- is based on:
  - British Geological Survey Geosure Classes
  - Consideration of Draft ISO Standard 20074 - Pipeline transportation systems – Geological hazard risk management for onshore pipelines.
  - ASME B31.8S
  - Operator case studies
- Includes:
  - Identification of locations on the pipeline route which are susceptible to ground movement.
  - Advice on reducing loading applied to the pipeline.
  - Requirements for measuring and monitoring ground movement.
  - Mitigation and repair.

Checklist for identifying locations susceptible to ground movement

Hazard	Observed features	Criteria	Pipeline vulnerability
Land slide	Steep slope, indications of surface run-off erosion, waterlogged soil, ground fissures/tension cracks, displacement of surface features/vegetation	Average gradient of slope 30° – 45°	Pipeline traversing slope subject to bending and axial stress, aligned with slope subject to axial tension and compression
Frost heave and thaw settlement	Uplift of ground, subsequent settlement on thawing	Uneven mounds and settlement due to formation and melting of ice lens	External loading and large displacement
Subsidence	Surface settlement/collapse, continuous fissure, ground water pumping in action	Limestone or dolomite bedrock present within 30m of surface	Pipeline located in or within 200m
Earthquake	Area identified on UK seismic hazard map	peak ground acceleration on rock exceeds 0.2g	External loading

Part of GPG 20 checklist

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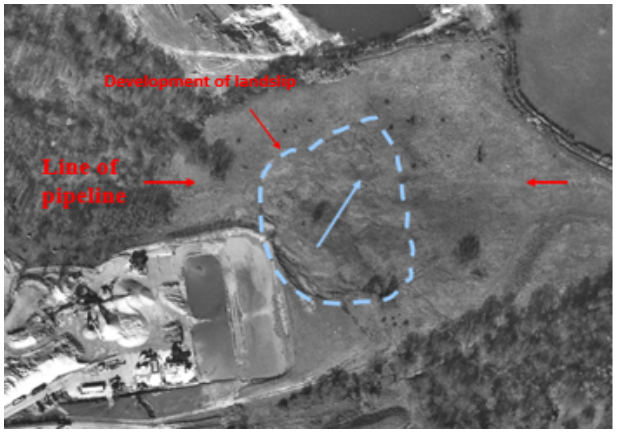
BGS GeoSure Classes

GeoSure Class	Description	% Spatial extent in Great Britain	Notes
E	Slope instability problems almost certainly present and may be active	~0.2	10% prone to land sliding
D	Slope instability problems are probably present or have occurred in the past	~1.1	
C	Slope instability problems may be present or anticipated	~8.5	
B	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on a site should always be considered	~81.6	90% not prone to land sliding
A	Slope instability problems are not thought to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered	~8.7	

Examples - Landsliding



Erosion at river crossing

Subsidence

Quarrying


Collapsed quarry face


Horizontal bending of pipeline at top of slope

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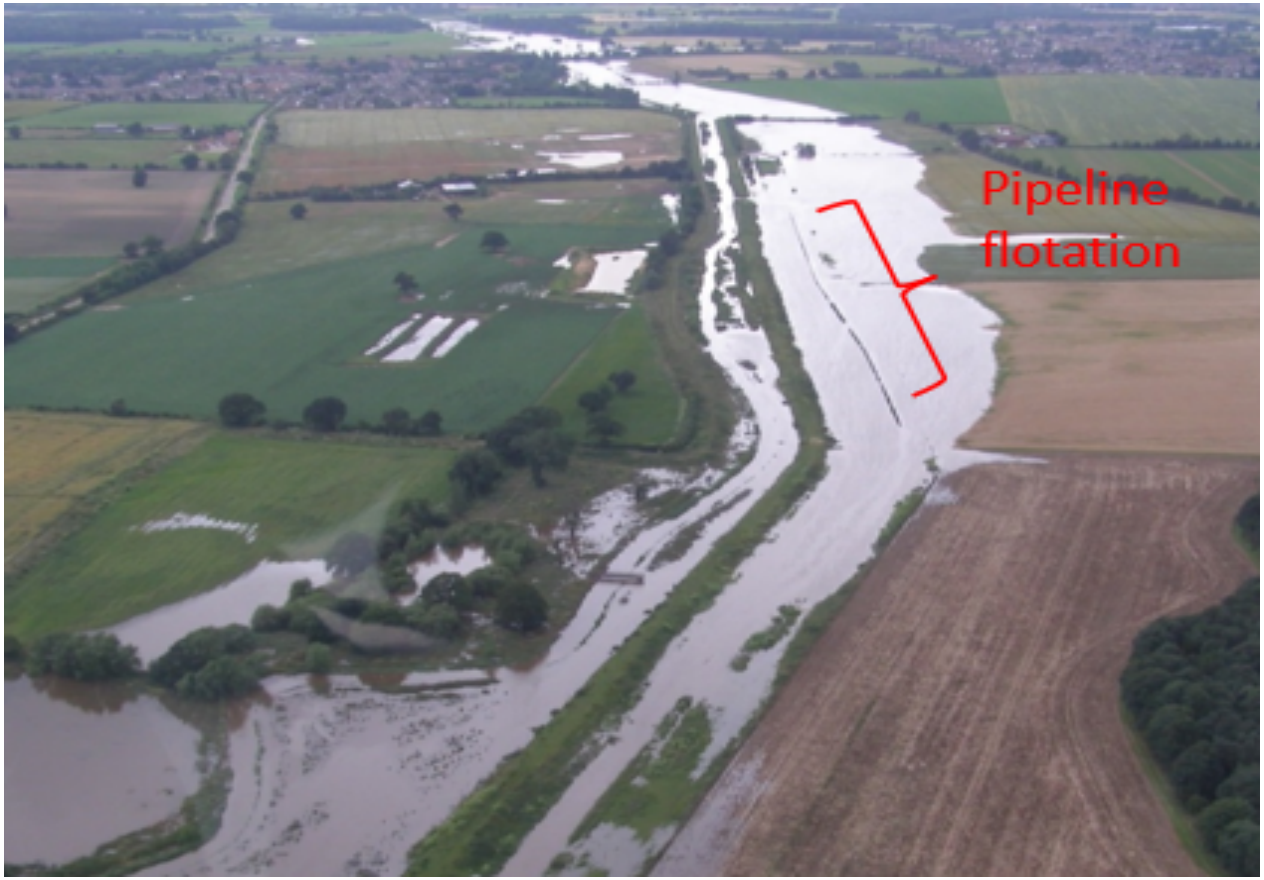
Flooding



Reducing loading on pipeline

- Working with the landowner/occupier to stop any work which has resulted in ground movement and/or reduce access to the affected location
- Carry out drainage work to reduce washout if required
- Carry out ground reinforcement works
- Excavating and exposing the affected pipeline section(s) to remove the applied loading
- Where the ground movement is perpendicular to the pipeline, opening a trench parallel to the pipeline
- Surrounding the pipe with low friction backfill materials

Monitoring, mitigation, repair

Monitoring

- Level monitoring
- Electronic Distance Measurement (EDM) monitoring
- Global Positioning System (GPS) spatial positioning
- Borehole inclinometers

Mitigation

- Excavation and exposure or parallel trench (short term)
- Dewatering, drainage, slope stabilisation, planting vegetation etc

Repair

- Applying stress relieving cuts and installing expansion units or sliding joints in areas of restricted access
- Installing pipeline repair sleeves
- Cut out and replacement of pipeline sections with pipe of thicker wall and higher material grade
- Pipeline diversion/rerouting

Questions?