

ISO 20257-1:2020-04 (E)

Installation and equipment for liquefied natural gas - Design of floating LNG installations - Part 1: General requirements

Contents		Page
Foreword		vii
Introduction		viii
1	Scope	1
2	Normative references	1
3	Terms, definitions and abbreviated terms	3
3.1	Terms and definitions	3
3.2	Abbreviated terms	8
4	Basis of design	11
4.1	Site and meteocean conditions	11
4.1.1	Site study	11
4.1.2	Earthquake	13
4.1.3	Location	13
4.1.4	Other studies	14
4.2	Design criteria	14
4.2.1	General	14
4.2.2	Topsides	15
4.2.3	Transfer systems	16
4.2.4	Hull	20
4.2.5	LNG storage	22
4.2.6	Mooring	23
4.2.7	Pipe-work	25
5	Health, safety and the environment	26
5.1	General	26
5.1.1	Main objectives	26
5.1.2	Main principles	26
5.2	Identification of safety and environmental barriers and design requirements	27
5.2.1	General	27
5.2.2	Purpose	27
5.2.3	Safety and environmental barriers	28
5.2.4	Generic barriers	28
5.2.5	Safety and environmental barriers identification process	29
5.2.6	Safety and environmental barriers design requirements	30
5.2.7	Safety and environmental barriers design requirements certification	30
5.3	Environmental considerations	31
5.3.1	General	31
5.3.2	Floating LNG installations specificities	31
5.3.3	Environmental aspects identification	31
5.3.4	Environmental design review	32
5.3.5	Environmental design requirements	32
5.4	Safety considerations	39
5.4.1	General	39
5.4.2	Safety strategies and philosophies	39
5.4.3	Safety reviews	40
5.4.4	Qualitative risk assessment, QRA and specific safety studies	42
5.4.5	Risk prevention measures (typical list)	46

5.4.6	Emergency response	59
5.5	Occupational health and industrial hygiene considerations	61
5.5.1	Occupational health and industrial hygiene aspects identification	61
5.5.2	Chemical exposure	61
5.5.3	Biological factor	62
5.5.4	Legionella	63
5.5.5	Thermal stress	63
5.5.6	Hot/cold surfaces	64
5.5.7	Support functions to operators - Project with permanent operators on- board or in the facility	64
5.5.8	Lighting	64
5.5.9	Water availability and quality intended for human consumption	65
5.5.10	Noise and vibration	65
5.6	Ergonomics and human factor	66
6	Mooring and stationkeeping	66
6.1	General	66
6.2	Permanent stationkeeping in open waters	67
6.2.1	Stationkeeping concepts	67
6.2.2	Design requirements	68
6.3	Permanent stationkeeping in nearshore or docked conditions	68
6.3.1	Stationkeeping concepts	68
6.3.2	Design requirements	69
6.3.3	Emergency departure of floating LNG installation	70
6.4	Mooring systems for special project design conditions	71
6.4.1	Disconnectable mooring	71
6.4.2	Permanent mooring for a limited project life	71
6.5	Short-duration mooring of a visiting LNGC for loading/unloading	72
6.5.1	General	72
6.5.2	Ship-to-ship mooring in open waters	72
6.5.3	Mooring in docked or nearshore conditions	72
6.5.4	Mooring to an SPM terminal	72
6.5.5	Design requirements	73
6.6	Infrastructure design for jetty moorings	73
6.6.1	General	73
6.6.2	Jetty elevation	74
6.6.3	Corrosion protection of the marine infrastructure	74
6.6.4	LNG spillage containment	74
6.6.5	Power supply from/to jetty to the FSRU/FLNG	74
6.6.6	Navigation aids	74
6.6.7	Emergency response and evacuation route	74
6.7	Transfer of material and personnel	75
7	Hull design	75
7.1	Hull structural design	75
7.1.1	Design philosophy	75
7.1.2	Design methods	76
7.1.3	Codes and standards	76
7.1.4	Limit states for floating structures	76
7.1.5	Design situations for ULS	76
7.1.6	Design situations for SLS	77
7.1.7	Design situations for FLS	77
7.1.8	Design situations for ALS	77
7.1.9	Site-specific design	78
7.1.10	Cargo containment loads	78
7.1.11	Fatigue	78
7.1.12	Slamming	79
7.1.13	Green water	79
7.1.14	Topsides and external loads	79
7.1.15	Accidental loads	79
7.2	Stability and watertight integrity	80

7.2.1	General	80
7.2.2	Stability	80
7.2.3	Watertight and weathertight integrity	80
8	LNG storage	81
8.1	General	81
8.2	Sloshing loads	81
8.2.1	Intermediate filling levels: Operating conditions of FSRU/FLNG	81
8.2.2	Intermediate filling levels: Operating conditions of cargo transfers (STS)	82
8.3	Boil-off gas management	83
8.4	Rollover prevention management	83
8.4.1	Background	83
8.4.2	Detection and prevention	83
8.5	Vent systems for LNG storage	84
8.5.1	General	84
8.5.2	Pressure relief systems	84
8.5.3	Vacuum relief systems	85
9	LNG transfer system	85
9.1	Functional requirements	85
9.2	Design of transfer systems	86
9.2.1	Operating envelope	86
9.2.2	Transfer system design	87
10	Boil-off gas handling and recovery	89
10.1	General	89
10.2	BOG collection system	89
10.3	System of gas return to LNGC or to FLNG facility	90
10.4	Boil-off gas recovery	90
10.5	Gas compressor	90
10.6	Flare/vent	91
11	Low temperature pipework	91
11.1	General	91
11.2	Piping components	91
11.2.1	General	91
11.3	Pipe	91
11.3.1	General	91
11.3.2	Pipe joints	92
11.3.3	Pipe supports	92
11.3.4	Compensation of contractions due to cold	92
11.3.5	Differential displacement between offshore structures	92
11.4	Valves	92
11.4.1	Relief valves	93
11.5	Thermal insulation	94
11.5.1	General	94
11.5.2	Piping insulation	94
11.5.3	Fire behaviour	94
11.5.4	Gas absorption	94
11.5.5	Moisture resistance	95
11.5.6	Differential movements	95
11.5.7	Thickness determination	95
11.6	Prevention of zinc contamination of austenitic steel	95
12	Utilities systems	96
12.1	Classification of systems	96
12.1.1	Essential services	96
12.1.2	Emergency services	96
12.2	Electrical	97
12.2.1	Design and engineering principles	97
12.2.2	Electrical system design	97
12.2.3	Design and selection of equipment and cables	100

12.3	Instrument air system	101
12.4	Hydraulic systems	101
13	Process and safety control and monitoring systems	101
13.1	General description	101
13.2	Process control system	102
13.2.1	Principle	102
13.2.2	Process control system design	102
13.3	Marine control system	102
13.4	Interfaces floating LNG installation/onshore	103
13.5	Safety control system (safety instrumented and F&G control systems)	103
13.5.1	Principle	103
13.5.2	ESD and safety actions	103
13.5.3	System capabilities	104
13.6	Closed circuit TV	104
13.7	Metering	105
13.7.1	Background	105
13.7.2	Cargo metering	105
13.8	Communications	105
13.9	Environmental monitoring and control	105
14	Security management	106
14.1	General	106
14.2	Offshore access	106
14.3	Onshore access	106
15	Commissioning	107
15.1	General	107
15.2	Systemization and schedule	107
15.3	Implementation	107
15.4	Safety	108
15.5	Organization	109
15.6	Handover	109
15.7	Start-up and performance test	109
16	Inspection and maintenance	109
16.1	General	109
16.2	Specific requirements for floating LNG installations	110
16.2.1	Cargo tank	110
16.2.2	Mooring	110
16.2.3	Process piping systems	110
16.2.4	Transfer systems	110
17	Preservation and corrosion protection	110
17.1	Specific requirements for non-seagoing vessels	110
17.2	Painting and coating	110
17.3	Cathodic protection	111
17.4	Impact of use of seawater as heating medium and active fire protection	111
18	Preparation for operations	111
19	Specific requirements for conversion of existing installations to floating LNG installations	111
	Annex A (informative) Risk-based analysis	113
	Annex B (informative) Safety studies	117
	Annex C (normative) Definition of reference flow rates for LNG boil-off calculations	124
	Annex D (normative) Design basis and criteria of an LNG transfer system	128

Annex E (informative) Seismic classification 140
Annex F (informative) Assessment of novel technology 143
Annex G (informative) Environmental, occupational health and industrial hygiene aspects 146
Bibliography 151