

DIN EN ISO 16530-1:2017-11 (E)

Petroleum and natural gas industries - Well integrity - Part 1: Life cycle governance (ISO 16530-1:2017)

Contents		Page
European foreword		6
Foreword		7
Introduction		8
1	Scope	9
2	Normative references	10
3	Terms and definitions	10
4	Abbreviated terms	18
5	Common elements of the well integrity life cycle	19
5.1	General	19
5.2	Well integrity	19
5.3	Well integrity policy	20
5.4	Well integrity management system	20
5.5	Risk assessment	20
	5.5.1 General	20
	5.5.2 Risk register	21
	5.5.3 Well type risk profile	22
5.6	Organizational structure and tasks	22
5.7	Barriers	22
	5.7.1 General	22
	5.7.2 Barrier philosophy	23
	5.7.3 Well barriers	23
	5.7.4 Operational barriers	25
	5.7.5 Human barriers	25
	5.7.6 Administrative controls	25
	5.7.7 Impact barriers	26
5.8	Performance standards for equipment	26
	5.8.1 General	26
	5.8.2 Well operating limits	26
5.9	Well barrier verification	27
	5.9.1 General	27
	5.9.2 Function testing	27
	5.9.3 Barrier verification testing	27
	5.9.4 Direction of flow	28
	5.9.5 Effects of temperature	29
	5.9.6 Modelling verification	29
5.10	Reporting and documentation	29
	5.10.1 General	29
	5.10.2 Well integrity status reporting	29
	5.10.3 Well life cycle phase deliverables	30
	5.10.4 Well handover process	31
5.11	Management of change	31
	5.11.1 General	31
	5.11.2 MOC process	31
	5.11.3 Dispensation from the WIMS	32

5.12	Continuous improvement.....	32
5.12.1	General.....	32
5.12.2	Key performance indicator monitoring.....	32
5.12.3	Lessons learned.....	33
5.13	Auditing.....	33
5.13.1	General.....	33
5.13.2	Audit process.....	33
6	Basis of design phase.....	33
6.1	Basis of design phase objectives.....	34
6.2	Organizational structure and tasks.....	34
6.3	Well barriers.....	35
6.4	Hazard identification and assessment.....	35
6.5	Well integrity considerations for the basis of design.....	36
6.5.1	General information to be provided.....	36
6.5.2	Well objectives and life cycle.....	36
6.5.3	Inflow requirements.....	36
6.5.4	Outflow requirements.....	37
6.5.5	Well location and targets.....	37
6.5.6	Prognoses regarding geological formations, pore pressure, formation strength and temperature.....	37
6.5.7	Data acquisition requirements.....	37
6.5.8	Other considerations for well integrity.....	38
6.5.9	Production and injection characteristics affecting well integrity through the life cycle.....	38
6.6	Quality assurance and approval process.....	38
6.7	Deliverables.....	38
7	Well design phase.....	39
7.1	Well design phase objectives.....	39
7.2	Organizational structure and tasks.....	39
7.3	Risk controls in well design.....	40
7.3.1	Risk register.....	40
7.3.2	Lessons learned.....	41
7.3.3	Well life cycle risk considerations.....	41
7.3.4	Additional considerations during well design.....	42
7.4	Well barriers.....	44
7.4.1	General.....	44
7.4.2	Well barrier plan.....	44
7.4.3	WBE design performance standards.....	45
7.4.4	Verification of the final well barrier.....	46
7.4.5	Emergency shutdown related safety systems.....	46
7.5	Well operating limits.....	47
7.6	Contingency planning for well construction.....	47
7.7	Surveillance and monitoring requirements.....	47
7.8	Well design deliverables, reporting and documentation.....	48
8	Well construction phase.....	48
8.1	Well construction phase objectives.....	48
8.2	Organizational structure and tasks.....	49
8.3	Well programme.....	50
8.4	Well barrier schematic.....	50
8.5	Barrier verification.....	50
8.5.1	General.....	50
8.5.2	Wellhead movement and fatigue.....	50
8.5.3	Cement.....	50
8.5.4	Casing shoe testing.....	51
8.5.5	Wellhead seal profile.....	52
8.5.6	Tubular connections.....	52
8.5.7	Casing wear.....	52

8.6	Risk identification and assessment.....	52
8.7	Management of change.....	52
	8.7.1 Potential changes to the well plan	52
	8.7.2 Suspended well considerations	53
8.8	Deliverables (reporting and documentation)	53
	8.8.1 Well handover information.....	53
	8.8.2 Risk register.....	54
8.9	Continuous improvement.....	54
9	Well operational phase.....	54
9.1	Well operational phase objectives.....	54
9.2	Organizational structure and tasks.....	55
9.3	Well barriers.....	55
	9.3.1 General.....	55
	9.3.2 Performance standards.....	55
	9.3.3 Leak rates.....	56
9.4	Well monitoring and surveillance.....	59
	9.4.1 General.....	59
	9.4.2 Monitoring and surveillance frequency.....	59
	9.4.3 Well operating limits.....	60
	9.4.4 Suspended and shut-in wells.....	61
	9.4.5 Visual inspection.....	61
	9.4.6 Well logging.....	61
	9.4.7 Corrosion monitoring.....	61
	9.4.8 Corrosion monitoring and prevention – external.....	62
	9.4.9 Erosion monitoring.....	62
	9.4.10 Structural integrity monitoring.....	62
	9.4.11 Well elevation monitoring.....	63
	9.4.12 Reservoir subsidence.....	64
9.5	Annulus pressure management.....	64
	9.5.1 Management considerations.....	64
	9.5.2 Sources of annulus pressure.....	64
	9.5.3 Annulus pressure monitoring and testing.....	65
	9.5.4 Frequency of monitoring tubing and annulus casing pressures.....	66
	9.5.5 Investigation of annulus pressure.....	66
	9.5.6 Maximum allowable annulus surface pressure.....	67
	9.5.7 Maintaining annulus pressure within the thresholds.....	69
	9.5.8 Review and change of MAASP and thresholds.....	69
9.6	Well maintenance.....	70
	9.6.1 General.....	70
	9.6.2 Replacement parts.....	70
	9.6.3 Frequency of maintenance.....	71
	9.6.4 Component testing methods.....	72
9.7	Risk assessment of well integrity failure and its management.....	72
	9.7.1 General.....	72
	9.7.2 Integrity failure ranking and prioritization.....	72
	9.7.3 Well failure model.....	72
9.8	Reporting and documentation.....	73
9.9	Periodic well review.....	74
	9.9.1 Well use review.....	74
	9.9.2 End of well life review.....	74
9.10	Change of well use.....	75
9.11	Well stock performance review.....	75
9.12	Continuous improvement.....	77

10	Well intervention phase	77
10.1	Well intervention phase objectives	77
10.2	Organizational structure and tasks	78
10.3	Well handover.....	79
10.4	Well intervention programme	79
10.5	Well barriers	79
	10.5.1 General.....	79
	10.5.2 Well barrier plans	80
	10.5.3 Well barrier qualification.....	80
	10.5.4 Well barrier verification.....	80
	10.5.5 Well operating limits	80
10.6	Risk management.....	80
10.7	Management of change.....	81
10.8	Deliverables (documentation and reports).....	81
11	Well abandonment phase	81
11.1	Well abandonment phase objectives.....	81
11.2	Organizational structure and tasks.....	82
11.3	Well abandonment programme	83
11.4	Well barriers for abandonment.....	83
	11.4.1 General.....	83
	11.4.2 Well barrier material selection and qualification.....	84
	11.4.3 Well barrier placement, configuration and redundancy.....	84
	11.4.4 Well barrier verification.....	84
	11.4.5 Reference documents for well abandonment barriers.....	84
11.5	Risk management.....	85
11.6	Management of change.....	85
11.7	Deliverables (documentation and reports).....	85
	Annex A (informative) Risk assessment techniques	87
	Annex B (informative) Risk register	90
	Annex C (informative) Example of well integrity roles and responsibilities chart	93
	Annex D (informative) Example of a well integrity competence matrix	94
	Annex E (informative) Examples of well barrier elements, functions and failure characteristics ...96	
	Annex F (informative) Examples of well barriers during the well life cycle and a well barrier schematic	99
	Annex G (informative) Example of performance standard for well barrier elements	104
	Annex H (informative) Function testing by analysing hydraulic signature	106
	Annex I (informative) Determination of leak rate	108
	Annex J (informative) Well handover	112
	Annex K (informative) Examples of key performance indicators	114
	Annex L (informative) Example of hazard identification checklist	115
	Annex M (informative) Example plot of pore pressure versus formation strength	116
	Annex N (informative) Well barrier element performance requirements	117
	Annex O (informative) Example of leak testing of gas-lift valves	118
	Annex P (informative) Example of well operating limits	120
	Annex Q (informative) Example of possible well leak paths	122
	Annex R (informative) MAASP calculations	123
	Annex S (informative) Example of a change in MAASP calculations	129
	Bibliography	131