List of All Sustainability Indicators

Table A.1: Nuclear Energy Indicators used in Previous Sustainability Reports. In the Reference column, capitalised letters denote indicators which are explicitly mentioned. Lower-case letters denote indicators which are inferred either individually or as part of a group.
A, a: denotes Reference (1).
B, b: denotes Reference (2).
C, c: denotes Reference (3).
D, d: denotes Section 8 of Reference (4).
E, e: denotes Section 2 of Reference (4).
F, f: denotes Reference (5).
G, g: denotes Reference (6).
H, h: denotes Reference (7).
I, i: denotes Reference (8).

Indicator Label	Indicator	Reference
E1	Global Warming Potential [kg(CO_2)eq/kWh]	A, b, E, F, g, h, I
E2	Freshwater Eco-toxicity Potential [kg(1-,4-DCB)eq/kWh]	A, b, e, g, h, i
E3	Marine Eco-toxicity Potential [kg(1-,4-DCB)eq/kWh]	A, b, e, g, h, i
E4	Ozone Depletion Potential [kg(CFC-11)eq/kWh]	A, b, E, g, h
E5	Acidification Potential [kg(SO_2)eq/kWh]	A, b, E, g, h, i
E6	Eutrophication Potential [kg(PO_4^{3-})eq/kWh]	A, b, E, g, h, i
E7	Photochemical Smog Potential [kg(C_2H_4)eq/kWh]	A, b, e, g, h, i
E8	Land Occupation [m^2yr/kWh]	A, b, e, f, i
E9	Greenfield Land Use [%]	A, b, e, f, i
E10	Terrestrial Eco-toxicity Potential [kg(1,4-DCB)eq/kWh]	A, b, e, g, h, i
E11	Recyclability of Input Materials [%]	A
E12	Freshwater Consumption [l]	B
E13	Freshwater Withdrawals [l]	B
E14	Disposal Space [m^2/yr] or [ha/GWh]	B, e, f
E15	Noise Pollution	E, I
E16	Change of Landscape	E, I
E17	Bio-Diversity/Species "Eco-system"	E
E18	Release of Hydrocarbons Following Accident [tCO_2eq/kWh]	I
E19	Area of Land Contaminated from Nuclear Accident [km^2/kWh]	I
E20	Application of ALARP to Limit Environmental Effects	H
E21a	Use of Abiotic Resources (Elements) [kg Sb(eq)/kWh]	A, I
E21b	Use of Abiotic Resources (Fossil Fuels) [MJ/kWh]	A, E, I
E21c	Use of Aluminium	E, g
E21d	Use of Iron	E, g

E21e	Use of Copper	E, g
E21f	Use of Other Non-Renewable Natural Resources	g, H
E21g	Use of Other Renewable Natural Resources	G
T1	Total Levelised Cost of Electricity [£/kWh]	A, H, I
T1a	Total Cost of Electricity [£/kWh]	B
T2	Capital Cost [£]	F, G, H, I
T2a	Capital Cost (Reactor) [£]	A, D
T2b	Overnight Construction Costs (LCC) [£]	C
T2c	Overnight Construction Costs (Risk to Capital) [£]	b, C
T3	Operation and Maintenance Cost [£/kWh]	A, D
T3a	Marginal Cost [£/kWh]	G
T3b	Waste Operational Costs (Interim Storage to DGD) [£/kWh]	H
T3c	Decontamination and Decommissioning Costs (Reactor) [£/kWh]	D, f, H
T3d	Total Repository Cost [£]	D, f, H
T4	Levelised Fuel Cycle Cost [£/kWh]	A, B, D, f
T5	Fuel Price Sensitivities [£/kWh]	A, I
T6	Financial Incentives [£/kWh]	A
T7	Disposal Costs [£/kWh]	B
T8	Discount Rate [%]	G
T9a	U_3O_8 Consumption [kg/kWh]	B, G, H
T9b	ThO_2 Consumption [kg/kWh]	H
T10	Cost of Raw Materials [£/U_3O_8]	c, F, g
T11	Cost of Separation Work [£/SWU]	c, F, g
T12	Cost of Conversion [£/UO_2]	c, F, g
T13	Cost of Fabrication [£/Fuel Form]	c, F, g
T14	Cost of Storage [£/Fuel Form]	c, F, g
T15	Cost of Reprocessing [£/UO_2_Rep]	c, F, g
T16	Cost of Transport [£.kg/km]	c, F, g
T17	Cost of Encapsulation and Condition [£/kg(SF)]	F
T18	Cost of Disposal [£/kg(SF)]	F
T19	Cost of Governmental Research [£]	d, F
T20	Cost of Non-Governmental Development [£]	d, F
T21	Cost of Basic R&D [£]	d, F
T22	Cost of Laboratory/Process [£]	d, F
T23	Cost of Pre-Industrial [£]	d, F
T24	Cost of Industrial [£]	d, F
T25	Capacity Factor [%]	A, i
T26a	Availability Factor [%]	A, I
T26b	Forced Outage Rate	C
T27	Technical Dispatchability [Rank]	A, H, i
T28	Economic Dispatchability [#]	A, H
T29a	Lifetime of Global Uranium Reserves at Current Extraction Rates [kgU]	A, C, I
T29b	*Lifetime of Global Thorium Reserves at Current Extraction Rates [kgTh]*	*This Work*

T30	Plant Flexibility [yr^{-1}]	A, H
T31	Construction Duration (LCC) [£/yr]	C
T32a	Construction Duration (Risk to Capital) [£/yr]	b, C
T32b	Time Between Plant Start-Up and Start of Construction [yr]	A, I
T32c	Technological Innovation/Improvements [Patents/kWh]	G
T33	Added Value "Income Generation"	E
T34	R/P Ratio	E
T35a	Energy Recovered per kgU	F, H
T35b	Energy Recovered per kgTh	H
T35c	Energy Recovered per kg of Limited Non-Renewable Resource Consumed	H
T36a	Ratio of Necessary Energy Input to Obtained Output	F, H
T36b	Power Available for Use in the Innovative Nuclear System	H
T37	Range of Ton-Kilometres Energy Intensity Ratio	F
T38	Cost of Incorporating Intrinsic and Extrinsic Measures to Improve PR	H
T39	Availability of Waste Management Technology	H, I
T40	Time Required to Industrialise Waste Management Technology	H
T41	Availability of Resources to Meet Radioactive Waste Demand	H
T42	Financial Figures of Merit	H
T43	Licensing Status	H
T44	Financial Robustness Index of Innovative Nuclear System	H
T45	Status of Legal Frameworks	H
T46	Status of States Capability for the Nuclear Fuel Cycle	H
T47	Availability of Credit Lines	H
T48	Size of Installation	H
T49	Availability of Infrastructure to Support Owner/Operator	H
T50	Availability of Human Resources	H
T51	*Challenges in Licensing Technology (Qualitative Score)*	*This Work*
SO1	Direct Employment [person-yrs/kWh]	A, E, f, g, I
SO2	Indirect Employment [person-yrs/kWh]	A, f, g
SO3	Proportion of Staff from Locality [%]	A
SO4	Spending on Local Suppliers [%]	A
SO5	Direct Investment in Local Community [%]	A
SO6	Corruption from Supplier Countries [Score]	A
SO7	Imported Fossil Fuel Avoided [toe/kWh]	A
SO8	Fuel Import Dependency	E, I
SO9	Diversity of Fuel Supply Mix [Score]	A, I
SO10	Fuel Storage Capabilities [GJ/m^3]	A
SO11	Education [# of Courses]	G
SO13	Mass of Depleted U [kg/kWh]	B
SO14	Public Health [£/kWh]	G
SO15	Change in Work Opportunity	F
SO16	Resettlement Necessities	E

SO17	"Public Acceptance" NIMBY/BANANA	E, f, H
SO18	"Risk Aversion" Kind of Risk Constraints	E, f
SO19	"Risk Aversion" Nature of Risk Source	E, f
SO20	"Risk Aversion" Dimensions of Risk Consequence	E, f
SO21	Human Toxicity Potential [kg (1,4-DCB)eq/kWh]	A
SO22	Volume of Liquid CO_2 to be Stored [m^3/kWh]	A
SO23	Autonomy of Resources	F
SO24	Induced Industrial Production	F
SO25	Long Term Commitment to Nuclear Option	H
SO26	Demand For and Price of Energy Products	H
SO27	Information Provided to the Public	H
SO28	Participation of the Public in Decision Making	H, I
SO29	Government Policy	H
SO30	Attitude to Safety and Security	H
SO31	Perceived Risk Characteristic from Normal Operation	I
SO32	Perceived Risk Characteristic from Accidents	I
SO33	Potential of Energy System Induced Conflicts	I
SA1a	Operational Accidents [#/yr]	B, F
SA1b	Calculated Frequency of Occurrence of Design Basis Accidents	H
SA1c	Calculated Frequency of Major Release of Radioactive Materials into the Environment	H
SA1d	Expected Frequency of Abnormal Operation and Accidents	H
SA1e	Expected Frequency of Failures of Disturbances	H
SA2	Core Damage Frequency [#/yr]	B
SA3	Potential Damage of Severe Accidents (Range) [m]	E
SA3a	Consequence of Abnormal Operation	H
SA3b	Consequence of Accidents	H
SA4	Accident Exposures	C, H
SA4a	Health Impact of Accidents on Workers	E, h
SA4b	Health Impact of Accidents on Public	E, h
SA5a	Estimated Peak Dose Rate [mrem/yr]	B
SA5b	Maximum Individual Dose to Public	B, D
SA5c	Maximum Individual Dose to Workers	B, D
SA6	Fatalities Due to Large Accidents [# Fatalities/GWh]	A, I
SA6a	Worker Fatalities [# Fatalities/GWh]	A, D
SA6b	Maximum Credible Number of Fatalities per Accident [Fatalities/Accident]	I
SA6c	Expected Number of Fatalities from Successful Terrorist Attacks [Ordinal]	I
SA6d	*Fatalities in Normal Operation (without Large Accident)*	*This Work*
SA7	Number of Latent Cancer Fatalities [#]	B
SA8	Total Human Health Impacts from Radiation [DALY/GWh]	A, D, I
SA8a	Public Human Health Impacts from Radiation [DALY/GWh]	E
SA8b	Worker Human Health Impacts from Radiation [DALY/GWh]	A, E
SA8c	Reduced Life Expectancy Due to Normal Operation	I

	[YOLL/GWh]	
SA9a	Collective Dose to Public [mrem/yr]	B, c, D, f, G, H
SA9b	Collective Dose to Workers [mrem/yr]	B, c, D, f, H
SA10	Discharged Waste Heat	B, C, E
SA11	Transports of Radioactive Waste[#]	B
SA12	Reliable Reactivity Control	C, h
SA13	Reliable Decay Heat Removal	C, h
SA14	Dominant Phenomena Uncertainty	C
SA15	Long Fuel Thermal Response Time	C, H
SA16	Integral Experiments Scalability	C, H
SA17	Source Term	C
SA18	Mechanisms for Energy Release	C
SA19	Long System Time Constraints	C, H
SA20	Long and Effective Holdup	C
SA21a	Passive Safety Features	C, H
SA21b	Active Safety Features	H
SA22	Robustness of Design	H
SA22a	Sub-Criticality Margins	H
SA23a	High Quality of Operation	H
SA23b	Capability to Inspect	H
SA24	Reliability of Engineered Safety Features	H
SA25	Number of Confinement Barriers Maintained	H
SA26	Capability of Engineered Safety Features to Restore Innovative Nuclear System to a Controlled State	H
SA27	Calculated Frequency of Major Release of Radioactive Materials into Containment/Confinement	H
SA28	Ability to Control Relative System Parameters and Activity Levels in Containment	H
SA29	In-Plant Severe Accident Management	H
SA30	Independence of Different Levels of DID	H
SA31	Evidence that Human Factors are Addressed Systematically in the Plant Life Cycle	H
SA32	Application of Formal Human Response Models from Other Industries or Development of Nuclear	H
SA33a	Stored Energy	H
SA33b	Flammability	H
SA33c	Criticality	H
SA33d	Inventory of Radioactive Materials	H
SA33e	Available Excess Reactivity	H
SA33f	Reactivity Feedback	H
SA34	Confidence in Innovative Components and Approaches	H
SA35	Safety Concept Defined	H
SA36	Clear Process for Addressing Safety Issues	H
SA37	RD&D Defined and Performed and Database Developed	H

SA38	Computer Codes or Analytical Methods Developed and Validated	H
SA39	Scaling Understood and/or Full Scale Tests Performed	H
SA40	Degree of Novelty of the Process	H
SA41	Use of Risk Informed Approach	H
SA42	Uncertainties and Sensitivities Identified and Appropriately Dealt With	H
SA43	Long Term Safety from Radioactive Waste	H
SA44	Radioactive Emission Control Measures from Waste Management Facility	H
SA45	Waste Forms	H
WA0	Total Activity [Bq/GWh]	H
WA1	HLW Disposal Mass [kg/GWh]	B, c, g, h
WA2	HLW Disposal Volume [m^3/GWh]	a, B, c, D, e, f, g, h, i
WA2a	Volume of Alpha-emitters from HLW	F
WA2b	Volume of Gamma-emitters from HLW	f, h
WA3	HLW Radiological Hazard Potential	B
WA4	Thermal Output of HLW after 50 years	D
WA5	Volume of ILW	a, c, D, e, f, g, h, i
WA6a	Mass of ILW	c, g, h
WA6b	Mass of LLW	c, g, h
WA7	LLW Solid Waste (Volume) [m^3/GWh]	a, B, c, D, e, f, g, h
WA7a	Volume of Alpha-Emitters from LLW	F
WA7b	Volume of Gamma-Emitters from LLW	f, h
WA8	LLW Gaseous Releases [kg/GWh]	B, c, g, h
WA9	Radiotoxicity of Gaseous Releases	c, D, e
WA10	LLW Liquid Releases [m^3/GWh]	B, c, g, h
WA11	Radiotoxicity of Liquid Releases	c, D, e
WA12	Non-Radioactive Toxic Waste	c, E, g, h, I
WA13	Non-Radioactive Non-Toxic waste	C, E, g, h
WA14	Operational Waste	C, D, g, h
WA15	Decommissioning Waste	C, D, g, h
WA16	Length of Repository Gallery Required for Waste	D
WA17a	Time of Confined Alpha-Emitters	E, F
WA17b	Time of Confined Gamma-Emitters	E, F
WA18a	Radiotoxicity at 500 years	C, D
WA18b	Radiotoxicity at 10,000 years	C, D
WA18c	Radiotoxicity at 1,000,000 years	C, D
WA19a	Radiotoxicity Flux Released into the Biosphere (0-10,000 y)	C, D
WA19b	Radiotoxicity Flux Released into the Biosphere (10,000-100,000 y)	C, D
WA19c	Radiotoxicity Flux Released into the Biosphere (100,000-	C, D

	1,000,000 y)	
WA20a	Dose to Human Intrusion at 300 years	C, D
WA20b	Dose to Human Intrusion at 10,000 years	C, D
WA21	Required Isolation Time (To Reach 10 mSv Intervention Level)	D, H
WA22	Appropriate Waste Classification Scheme	H
WA23	Time to Produce the Waste Form Specified for End State	H
WA24a	Waste Minimization Study	H
WA24b	Volume and Activity Reduction Measures	H
WA25	Process Descriptions that Encompass the Entire Waste Cycle	H
WA26	*Neutron Emission Rate per Spent Fuel Assembly after 50 years*	*This Work*
PR0	Proliferation Resistance	A, D, F, I
PR1	Mass of SNM [kg/GWh]	B, c, e, h
PR2	Required Enrichment Capacity [kgSWU/GWh]	B, e
PR3	Attractiveness of SNM	B, c, e, h
PR4	Mass of Separated Plutonium [kg/GWh]	B, c, e, h
PR5	Mass of Other Separated SNM/ANM [kg/GWh]	c, e, h
PR6	Extrinsic Proliferation Resistance	E
PR6a	Accountability of Nuclear Materials	H
PR6b	Amenability of Nuclear Materials	H
PR6c	Detectability of Nuclear Materials	H
PR7	Attractiveness of Nuclear Technology	H
PR8a	Difficulty to Modify Process	h
PR8b	Difficulty to Modify Facility Design	h
PR8c	Difficulty to Misuse Technology or Facilities	h
PR9	Redundancy of Intrinsic and Extrinsic PR Measures	H
PR10	Robustness of Barriers Covering Each Acquisition Path	H
PR11	PR Taken into Account Early as Possible in Design of INS	H
PR12	States Commitment, Policies and Obligations to Non-Proliferation	H
PR13	Verification of Extrinsic Measures by State and IAEA	H
PP1	"Public Security" Measures Against Terrorist Attacks	E, I
PP2a	Competent PP Authorities Designated, Empowered (with Responsibilities)	H
PP2b	Legislative and Regulatory PP Framework Development	H
PP2c	Responsibilities of PP Between Authorities and Facility Operator Defined	H
PP3a	Addressing of Synergies Between PR, PP, Safety and Operations	H
PP3b	Accounting of PP in All INPRO Areas	H
PP3c	Evidence of PP when Innovative Nuclear System is Shut-Down/Decommissioned	H
PP4	Is There a Trustworthiness Program (with Established Criteria)	H
PP5a	Has There Been Development of a Confidentiality Program	H
PP5b	Has the Confidentiality Program Been Implemented Over All Levels	H
PP6a	Is There Evidence of a DBT or Other Appropriate Threat	H

	Statement Which Has Been Developed	
PP6b	Are There Provisions for Periodic Review of Threat by the State	H
PP6c	Is There Evidence that the Concept of DBT (or Other) Been Used to Establish the PP System	H
PP6d	Has the Designer Introduced Flexibility in PPS Design to Cope with the Dynamic Nature of Threat	H
PP7a	Judicial Consequences Defined For Malicious Acts Against Nuclear Materials and Facilities	H
PP7b	Application of "Graded" Approach to PP Requirements	H
PP8	Definition and Implementation of Quality Assurance Policies to PP	H
PP9	Security Culture Developed and Implemented for All Organisations and Persons In Innovative Nuclear Systems	H
PP10a	Assessment of Potential Benefits of Terrain, Topography and Geography to Adversaries	H
PP10b	Assessment of Transportation and Off-Site Response Routes	H
PP10c	Consideration of Future Development and Encroachment by Public	H
PP11a	Consideration of PP to Design of Innovative Nuclear System Components	H
PP11b	Consideration of PP to Layout of Innovative Nuclear System Components	H
PP12a	Integration of DDAD, and Response to Achieve Timely Interruption	H
PP12b	PPS Designed to Account for Insider Adversaries	H
PP12c	Redundancy of PPS	H
PP13a	Assignment of Responsibilities for Executing Emergency Plans	H
PP13b	Established Capabilities of PP to Prevent/Mitigate Radiological Consequences of Sabotage	H
PP13c	Established Capabilities of PP to Recover Stolen Nuclear Materials or Recapture Nuclear Facility	H

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