

Sustainability Indicators for Open-Cycle Thorium-Fuelled Nuclear Energy

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The potential for countries which currently have a nominal nuclear energy infrastructure to adopt thorium-uranium-fuelled nuclear energy systems, using a once-through “open” nuclear fuel cycle, has been presented by the International Atomic Energy Agency. This paper highlights Generation III and III+ nuclear energy technologies that could potentially adopt an open thorium-uranium fuel cycle and qualitatively highlights the main differences between the open thorium-uranium and open uranium fuel cycles. Furthermore, 28 indicators (and corresponding metrics) have been identified that could elucidate the advantages and disadvantages of nuclear energy systems which utilise thorium-uranium fuels in an open cycle. Such systems will be compared to an AREVA EPR operating with a once-through uranium fuel cycle. The indicators determined in this work have been drawn by grouping 270 indicators from eight previous studies of indicators associated with holistic and specific appraisals of the various life-cycle stages associated with the nuclear fuel cycle. The 28 indicators cover techno-economic, environmental, waste, social, and proliferation-resistance themes and can be determined quantitatively, either by explicit determination or from an appropriate sensitivity analysis.

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