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(54) **NUCLEAR REACTOR TARGET ASSEMBLIES, NUCLEAR REACTOR CONFIGURATIONS, AND METHODS FOR PRODUCING ISOTOPES, MODIFYING MATERIALS WITHIN TARGET MATERIAL, AND/OR CHARACTERIZING MATERIAL WITHIN A TARGET MATERIAL**

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(57) **ABSTRACT**

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Target assemblies are provided that can include a uranium-comprising annulus. The assemblies can include target material consisting essentially of non-uranium material within the volume of the annulus. Reactors are disclosed that can include one or more discrete zones configured to receive target material. At least one uranium-comprising annulus can be within one or more of the zones. Methods for producing isotopes within target material are also disclosed, with the methods including providing neutrons to target material within a uranium-comprising annulus. Methods for modifying materials within target material are disclosed as well as are methods for characterizing material within a target material.

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