

X-1 Cryogenic Target System Design

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The X-1 Advanced Radiation Source is a high yield nuclear fusion laboratory being proposed by Sandia National Laboratory. To achieve high yield fusion, the X-1 design requires the use of cryogenic targets. These targets consist of a spherical plastic capsule with a layer of solid deuterium-tritium (DT) on the inside wall. This DT layer is obtained by first permeation filling the capsule with DT gas at room temperature. **The** filled capsule is then cooled to approximately 18 K to solidify the DT. **The** uniform layer is created through a process called "Beta Layering", **which** involves placing the capsule in a very uniform temperature environment. General Atomics has performed preconceptual design studies of a system designed to fill a target with DT, cool it down to cryogenic temperatures, and then insert it into the X-1 experimental chamber. **The** baseline system design uses a supercritical helium stream to cool the target. The helium is compressed by a room temperature compressor and cooled using both liquid nitrogen and liquid helium reservoirs. The cold supercritical helium then travels to the target through a 7.5 meter long umbilical tube. This umbilical allows the target to be at the center of the X-1 experimental chamber while the cryogenic equipment is safely outside the chamber. This paper will describe the preconceptual design of the X-1 Cryogenic Target System and present the supporting thermal analysis.

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