Design of Mock-up Target for the Spallation Neutron Source

The Spallation Neutron Source is a research facility currently under construction at Oak Ridge National Laboratory. The facility will produce neutrons by bombarding a mercury target with a beam of protons. The mercury is contained in a stainless steel vessel that must be replaced several times a year. The Mercury Target must be removed remotely due to high radiation. During Integrated System Testing, operators will practice removal and installation of the Mercury Target. A mock-up of the Mercury Target was needed to avoid potential damage to the Mercury Target that costs about one million dollars and would take months to reproduce. The objective of this project was to design a mock-up target of the real Mercury Target. A basic mock-up target existed at the start of the project. However, it differed significantly from the Mercury Target in many critical dimensions. The Mock-up Target was modified to mimic the Mercury Target in dimensions corresponding to transportation and placement. Before physically modifying the Mock-up Target, a computer aided design program, Pro/Engineer Wildfire 2.0 (Pro/E), was used to digitally model the initial Mock-up Target, compare it to the Mercury Target, and make drawings of the Mock-up Target to give to the fabricators. The Mock-up Target is considered as a "below hook lifting device" and is designed to comply with DOE Standard 1090, Section 14.2.1, which states that lifting devices must have a factor of safety of three based on the yield strength of the material. To check for this, a sub-program of Pro/E, Mechanica, was used to run finite element stress analysis on the part of the Mock-up Target that would be receiving the highest stresses. In addition to Mechanica analysis, stress calculations were done by hand. A formal stress analysis report was written to document that the Mock-up Target would comply with the DOE Standard. Although the Mock-up Target is not yet fabricated, the design is successful in that it fulfills the requirements in a safe and inexpensive way by modifying the current Mock-up Target to the proper specifications. The Mock-up Target will allow for remote handling practice that is as realistic as possible without the risk of using the million dollar Mercury Target.

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