K-SHELL RADIATION YIELDS ON
A 60 MA Z-PINCH GENERATOR*

J.L. Giuliani, J.W. Thornhill, A.L. Velikovich
Plasma Physics Division, Naval Research Laboratory,
Washington, DC 20375 USA

R.W. Clark
Berkeley Research Associates, Beltsville, MD 20905 USA

B. Jones, D.J. Ampleford, M.E. Cuneo,
W.A. Stygar, C.A. Coverdale
Sandia National Laboratories,
Albuquerque NM 87185 USA USA

Z-pinch driven plasmas produce the highest yield among K-shell line emission sources. Recently measured yields on the refurbished Z generator (~20 MA) include: 270 kJ for Al (E>1 keV); 75 kJ for stainless steel (SS, E>5 keV); and 25 kJ for Cu (E>5 keV). Gas puff experiments are planned for the summer of 2012 and predictions for the Ar (E>3.1 keV) K-shell yield are > 300 kJ. Clearly for a given generator the K-shell yields decrease as the atomic number of the load material increases. Of interest for future pulsed power generators of higher current is the enhancement in K-shell yields for the above materials, and the potential for significant yields above 10 keV from loads of higher atomic number. In this work we consider a 60 MA generator and examine the K-shell yields for Ar and SS, as well as for Kr (E>13 keV), Mo(E>18 keV), and Ag(E>22 keV). The simulations for the non-LTE radiation magneto-hydrodynamics are performed with 1D radial (DZAPP) and 2D r-z (MACH2-TCRE) codes. These simulations employ an equivalent circuit for the generator including current losses, use detailed configuration accounting including fine structure for the atomic physics with collisional-radiative equilibrium kinetics, and treat the line transport with the probability-of-escape formalism. The 60 MA driver is predicted to couple ~8 MJ into the load and produce over 2 MJ of Ar, ~1 MJ of SS, and ~200 kJ of Kr K-shell. For Mo the conversion efficiency to K-shell remains as high as ~1%, giving ~80 kJ. The effects of a larger current loss in the MITL and time dependent ionization kinetics will discussed.


*Work supported by the DOE/NNSA. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.