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Space Weather Influence on Power Systems: Prediction, Risk Analysis, and Modeling

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This report concentrates on dynamic probabilistic risk analysis of optical elements for complex characterization of damages using physical model of solid state lasers and predictable level of ionizing radiation and space weather. The following main subjects will be covered by our report: (a) solid-state laser model; (b) mathematical models for dynamic probabilistic risk assessment; and (c) software for modeling and prediction of ionizing radiation. A probabilistic risk assessment method for solid-state lasers is presented with consideration of some deterministic and stochastic factors. Probabilistic risk assessment is a comprehensive, structured, and logical analysis method aimed at identifying and assessing risks in solid-state lasers for the purpose of cost-e®ectively improving their safety and performance. This method based on the Conditional Value-at-Risk measure (CVaR) and the expected loss exceeding Value-at-Risk (VaR). We propose to use a new dynamical-information approach for radiation damage risk assessment of laser elements by cosmic radiation. Our approach includes the following steps: laser modeling, modeling of ionizing radiation in°uences on laser elements, probabilistic risk assessment methods, and risk minimization. For computer simulation of damage processes at microscopic and macroscopic levels the following methods are used: () statistical; (b) dynamical; (c) optimization; (d) acceleration modeling, and (e) mathematical modeling of laser functioning. Mathematical models of space ionizing radiation in°uence on laser elements were developed for risk assessment in laser safety analysis. This is a so-called ‘black box’ or ‘input-output’ models, which seeks only to reproduce the behaviour of the system’s output in response to changes in its inputs. The model inputs are radiation in°uences on laser systems and output parameters are dynamical characteristics of the solid laser. Algorithms and software for optimal structure and parameters of forecasting mathematical models of ionizing radiation are considered. Forecasting mathematical models of ionizing radiation by numerical methods has been tested.