

4⁺D VR Technology for Structural Analysis and Integrated Maintenance of Nuclear Power Plants

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Abstract

There continues to be an increasing demand of electricity around the globe to fuel the industrial growth and to promote the human welfare. The economic activities have brought about richness in our material and cultural lives, in which process the electric power has been at the heart of the versatile energy sources. In order to timely and competitively respond to rapidly changing energy environment in the twenty-first century there is a growing need to build the advanced nuclear power plants in the unlimited workspace of virtual reality (VR) prior to commissioning. One can then realistically evaluate their construction time and cost per varying methods and options available from the leading-edge technology. In particular a great deal of efforts have yet to be made for time- and cost-dependent plant simulation and dynamically coupled database construction in the VR space. The operator training and personnel education may also benefit from the VR technology. The present work is being proposed in the three-dimensional space and time plus cost coordinates, i.e. four plus dimensional (4⁺D) coordinates. The 4⁺D VR application will enable the nuclear industry to narrow the technological gap from the other leading industries that have long since been employing the VR engineering. The 4⁺D technology will help nurture public understanding of the special discipline of nuclear power plants. The technology will also facilitate public access to the knowledge on the nuclear science and engineering which has so far been monopolized by the academia, national laboratories and the heavy industry. The 4⁺D virtual design and construction will open up the new horizon for revitalization of the nuclear industry over the globe in the foreseeable future. Considering the long construction and operation time for the nuclear power plants, the preliminary VR simulation capability for the plants will supply the vital information not only for the actual design and construction of the engineered structures but also for the on-line design modification. In this regard it is of utmost importance to employ the 4⁺D VR technology for the nuclear power plants in their design stage as well as for the operating plants for optimal maintenance schedules and procedures. By using this technology one can perform structural design optimization needed for building the nuclear power plant. The 4⁺D VR design and construction optimization may result in savings of \$ 200~300 million per month of reduced construction time for the two units.