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

Il S. Lee, Sang H. Yoon, Kyu W. Shim, Yong H. Yu, Kune Y. Suh*
PhiloSOPHIA, Inc.

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.