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Position of Sandia National Laboratories with respect to Product Definition Standards

Sandia National Laboratories, in conjunction with the Department of Energy Computer Integrated Manufacturing Program, supports the use of the Department of Energy Data Exchange Format (DOEDEF) subset of IGES (the Initial Graphics Exchange Specification) for exchanges of mechanical product definition data between dissimilar computer aided systems of various tpyes. For the future, Sandia plans to incorporate PDES (Product Data Exchange Specification) /STEP (Standard for Exchange of Product Model Data) for such exchanges. This single international standard with two names is being developed under the auspices of the International Standards Organization (ISO) TC184/SC4/WG1. The American contribution (the PDES part of the name) has been coordinated by the IGES/PDES Organization which is chaired by Bradford Smith of the National Institute of Standards and Technology. Among the member- contributors to the IGES/PDES Organization have been five employees of the Computer Aided Design and Integration Department (2810) of Sandia National Laboratories. J. C. Kelly of Division 2811 was one of the earliest members of what is now known as the IGES/PDES voluntary Organization. Bob Parks of the same Sandia Division (2811) and Larry O'Connell of Division 2812 chair the Drafting Committee and the Electrical Applications Committee respectively of IGES/PDES.

The background for the above position is described below. At Sandia Labs, as at other Nuclear Weapons Complex agencies, a variety of Computer-Aided Design (CAD) systems and Computer-Aided Engineering (CAE) systems have been chosen, purchased, and used. In each case, the system chosen was selected and justified as the optimum for the job at hand. However, in many cases, the need for and the difficulty in communicating designs to other systems was underestimated.

Three sources of "flavors" in IGES which impede satisfactory exchange have been identified. First, there can be significant differences in the underlying data structures and mappings of the originating system and the target system. Second, the operator of the originating system may have exercised his or her originality very differently in the creation of the design file on that system. Thirdly, different application areas tend to use IGES entities somewhat differently. A strong commitment to exchange designs between roughly comparable CAD or CAE systems using a particular subset of a versatile neutral format can often produce acceptable exchanges. The strength of the commitment often meets its first test in the willingness of the operator of the originating system to sacrifice some originality to produce an exchange file with a tolerable kind and degree of flavoring. In the DOEDEF process, the commercially existing translator programs for each system were accepted as a given. Then, deflavoring software for a particular application area was written to convert the translated (but flavored) file into the DOEDEF subset. Given the application area and the target system, a reflavored file is produced to create an IGES file intelligible to the translation software in the target system.

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In an ideal world, there would be one and only one way to translate an entity in the originating system into the exchange format. In that case, deflavoring software and Application Protocols would not be needed. Ideally, also, there should be no need for reflavoring. If there was one and only one way to translate each element of the exchange file to the native data base in the target system, the need for reflavoring would vanish. Assuming the two systems involved in the intended exchange are comparable in capabilities and design philosophy, the other flavoring source is the choices made by the operator of the originating system. Guidelines may have to be developed and followed for each type of design application to insure recognizably uniform exchange files. PDES/STEP is addressing these sources of flavoring by developing conceptual information models and application protocols. The models should all but eliminate the varieties of ways to express modeled concepts. The application protocols should clarify the concepts needed for the given application. Again, guidelines may be needed for each application to help the operator capture the design in a way that is compatible with the assumptions made by the author of the translation software in the originating system. For example, the operator needs to know that an Electronic Schematic is much more useful if created using "Connect Points" and "Link Lines" than points and lines having no connectivity implications.

The question of which (and how many) of the four ANSI standards for electronic product definitions Sandia will support has not yet been settled. The Very High Speed Integrated Circuit (VHSIC) Hardware Definition Language (VHDL) looks like the best choice if the task at hand involves digital circuit simulation or digital circuit test definition. The Institute for Interconnecting and Packaging Electronic Circuits (IPC) standards look attractive for use in purchasing Sandia designed Printed Wiring Boards (PWB's) from outside suppliers. The Electronic Design Interchange Format (EDIF) seems to be widely supported by vendors of tools used in the design of Integrated Circuits at Sandia labs. IGES is being used for some ad hoc tasks in NC drilling of holes in PWB's and for quantitative pictorial description of Hybrid Microcircuits. It has some other capabilities for use in electronic product descriptions which have not yet been thoroughly evaluated.

We find that the standards for electronic product design are so diverse we are currently pursuing a common platform as a near term solution. The electrical applications in need of a better long term solution are: Integrated Circuits, Hybrid microcircuits, electronic subsystems, drafting, and fabrication. Moreover, it is not clear how hard it will be to convert design descriptions among the four standards nor how often that will be needed. In any case, information models for all the expected applications of the four standards seem sorely needed to support the development of application protocols and user guides for each task.