HITACHI PRODUCT DATA MANAGEMENT SYSTEM TOWARD THE 21ST CENTURY BY CALS APPROACH

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ABSTRACT

HIPDM21 (Hitachi Product Data Management System for the 21st century) is a comprehensive computer information management system which has been developed for the purpose of plant life cycle business support in terms of the electronics information exchange and sharing between the disciplines using the product data management technology. The system consists of core systems (Engineering Data Control System, Integrated Commodity Database system, and Document Management System) and business application systems. In the present development phase, the system is being enhanced to support CALS standards including EDI, SGML, and STEP, and to support information exchange and sharing with outside the company including clients, construction companies, and domestic/international vendors.

1. INTRODUCTION

In order to survive in this severe competition age for the power generation industry which is undergoing global changes in its business environment and experiencing hardship for securing orders from client companies, it is most urgent, as one of the most important strategies, to innovate and streamline its business activities thoroughly by adopting an electronic data exchange and sharing system.

In the plant industry, computers have been used widely throughout the life cycle of the plant from its design stage to maintenance activity for the purpose of reducing lead times in business activities, improving efficiencies, achieving cost reduction, quality improvement, safety assurance, and the like. Hitachi, Ltd. has already developed a three-dimensional CAD system for use in power generation plant engineering, and has successfully applied it to actual plants so as to spur advancements of plant engineering CAD/CAE systems and of a digital information exchange system 1). Further, Hitachi, Ltd. has been engaged in strengthening linkage among various plant engineering CAD/CAE systems having respective core engineering data bases, and developed a plant integrated CAE system having extendible application entities including a basic plan of the plant, detailed design, implementation design (plant interpreted design), construction plan and management, and put it into actual use 2).

However, functions of these systems are not sufficient to provide for a complete internal and external information exchange and sharing system applicable to the life cycle of the plant. As a first step for solving such problems, we have developed HIPDM21 (Hitachi Product Data Management System toward 21st century) which is an integrated electronic information management system operable under a personal computer client server network, and initiated its application to actual plants 3).

2. HIPDM21 SYSTEM

HIPDM21 is intended to provide for a CALS (Commerce At Light Speed) data exchange and sharing system, which accepts all information relating to the plant activities as electronic data, exchanges and shares such electronic data internally and externally, for example, with electric power companies, construction companies, and other related companies including component vendors on real time. Namely, its purpose is to integrate all information via network relating to the plant activities throughout its life cycle including its planning, design, manufacture, construction, operation and maintenance.

This system is comprised of four basic systems and respective application systems as indicated in Figure 2.1. Here, each application system is allowed also to access to design data, production process data, document information and management data via these basic systems. Thereby, concurrent engineering and paper-less business transaction environments will be realized by facilitating mutual access to plant related information including progress status of entire projects and their individual scheduling which are linked and maintained via respective work flow functions.

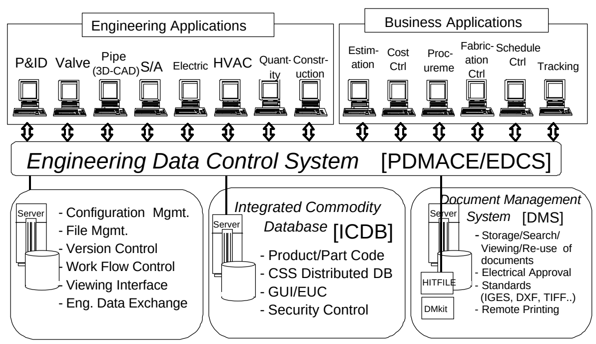

Figure 2.1 HIPDM21 System Architecture

Main functions of the basic systems will be described in the following.

(1) PDMACE (Product Data Management for Creative Engineering environment)

PDMACE which controls the whole stages of the life cycle of a product from its planning/designing to maintenance, and executes an integrated management of various application programs and data such as product CAD and CAE, is provided with file management/product configuration management functions, a version management function, a work flow function, and the like.

(2) EDCS (Engineering Data Control System)

EDCS which controls various flows of information regarding various activities to be performed concurrently in the nuclear plant engineering, is provided with: a work flow control function for controlling disclosure/revision management of engineering information and data; an administrative management of related information; and a data exchange function for exchanging data between different data bases of different activities 4).

(3) DMS (Document Management System)

DMS which unifies and maintains all the documents such as drawings and design specifications required for engineering activities in electronics formats and provides for personal computer/workstation environment accessible to such unified electronics documents from the design or production sites via network, is provided with a document retrieval function, a document registration/lending/reuse function, and an electronic examination/approval function.

(4) ICDB (Integrated Commodity Database System)

ICDB which includes a central data base and respective application data bases is a logically integrated data base system. This ICDB system is developed to realize a unified management of information by: sharing information and data such as engineering data/quantities/cost estimate/procurement/manufacture process/administration cost with other related departments; and executing an integrated data base management and repository management. Oracle 7 is used as its DBMS.

2.1 The First Stage Development

In the development of the first stage HIPDM21, application systems for engineering and management which includes basic planning, design, construction to test operation are connected via respective basic systems 5). At the time of connection of these application systems, such application systems which have been operated on host computer are down-sized to operate on EWS/PC and are improved of their functions. Further, their data bases are unified to Oracle7.

2.1.1 Forms of Application Linkage

Examples of forms or configuration of linkage connecting between different applications will be described specifically in the following.

(1) Linkage through data exchange

This type of linkage is provided for incorporating external data into internal data base. By this linkage through data exchange, declassified information in the internal data base is notified to other departments, which upon notification of any necessary information take a step to incorporate it into its own data base.

(2) Linkage through data retrieval

This type of linkage is provided for allowing data access and retrieval from external data bases of other departments and vice versa. By this linkage through data retrieval, necessary information is allowed to be retrieved from external data bases any time at discretion.

(3) Linkage through browsing of documents

This type of linkage is allowed by browsing of the drawings and documents having been registered in PDMACE. For this type of linkage, folder configurations and document registration formats have been preset, and respective designers or engineers are requested to enter their documents according to these formats.

2.1.2 Example of HIPDM21 System Linkage

(1) Linkage of Machine System Activities

Figure 2.2 shows relevancy of the machine system engineering activities. HIPDM21 was applied to this machine system engineering activities which include a project management activity, system design activity, valve design activity, piping route planning activity, and piping manufacture/implementation design activity.

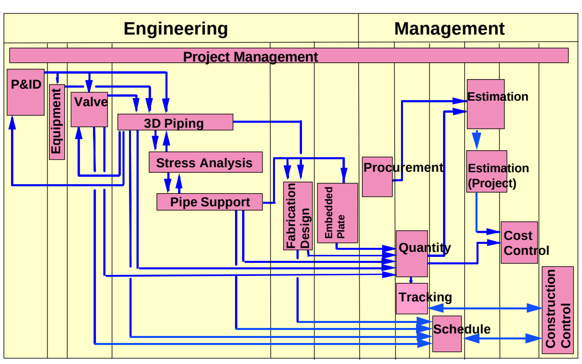

Fig 2.2 Application System Connection

Each project manager who by using the project management program operating on a personal computer makes engineering process planning, formulates an overall process flow, and distributes it to respective departments and sections as electronic data using the work flow.

Piping and instrument diagrams formulated by the piping design department are subjected to examination and approval on work flow, and are distributed as electronic exchange data to relevant sections via work flow. Further, at the same time with the distribution of the diagrams, disclosure processing of the system design data is executed.

The valve design section requests for the system design data to be transferred to its own data base using EDCS, draws a valve design specification including its structure and shape on the basis of the data transferred, and notifies the disclosure of the data to relevant departments and sections.

The piping route design section carries out three-dimensional piping layout planning on the display using EDCS with reference to the system design data provided from the data bases of the design sections (system design, valve design) in the upper stream, as well as the piping/instrument diagrams stored in PDMACE. Sections in charge of stress analysis of piping and piping support design are allowed to access to the three-dimensional data base for the piping routes and execute their tasks concurrently with the piping route planning. Access permission to the piping data (route release) and feedback from a stress analysis engineer to the piping route planner are notified using the workflow. Further, when strength of piping is verified as the result of stress analysis, a design start permission (plant interpreted design release) is registered and notified using the work flow to respective engineers concerned both within and outside the company in charge of plant manufacture and implementation design engineering including piping, supports, built-in hardware.

(2) Activity linkage between electrical systems

A category of general electrical activity applied here includes instrument design activities, instrumentation work planning activities and electrical work design activities.

A section involved in the instrument design activities is allowed to access to the system design data base via EDCS on-line and can reflect the result of access immediately on its instrument data base. Further, since the instrument data base is shared via the network also by other sections remotely located, management of all information on the side of planning sections and on the side of commerce transaction sections is simultaneously carried out. In order to execute instrument ordering activities, the transaction sections link this transaction information of the data base to an inter-division on-line ordering system which is interlocked with production management systems of the suppliers. Through these steps, an integrated information online system including all the phases from instrument planning to transaction or ordering can be realized.

The instrumentation work planning section is enabled not only to access from the electric system side to other data bases of electrical instrumentation, but also to both the system design data base and layout design (3D-CAD) data base simultaneously. Through provision of such arrangements, it becomes possible to gather and display all related information such as process piping information at detection origin of instrument, piping route information at detection end, and instrument specification information on the same screen of the display so as to be able to proceed respective design works efficiently.

With respect to the electrical design work, motor list data which summarizes specifications of motors provided within the plant is stored in electronics file to allow access from respective design sections for data reference and data entry on respective personal computers using dedicated software. Then, the motor list data in electronics file is circulated to respective design sections using the work flow for data reference and data collection.

(3) Data Linkage between Administrative Activities

In the engineering activities, management of various costs and procurement control is important. Further, it is required to maintain close contacts and coordination with work sites of construction. Engineering data bases at respective design sections are linked via HIPDM21 with administrative systems such as for supervising cost estimate/balance control activities, material procurement control activities, management at construction sites and the like, thereby enabling continuous and integrated processing of these activities which have been executed separately. Quantity control system tabulates quantities based on information supplied from the engineering data bases, and enters the result of tabulation into its data base. Further, the quantity information accessed to is used in formulation of budget information. This budget information is linked on-line to the balance control system, thereby allowing immediate reference to its work in process. As to procurement management, placement of purchase orders and its control based on respective budgets are executed by the material control system, and liaison and coordination of material purchase and procurement activities are performed using the workflow.

The construction site management system which is linked via network with the local construction site data bases allows on-line access to information and its display regarding a progress status of construction such as work in progress and quantities from remote design sections.

2.2 The Second Stage Development Plan

In the second stage of development of HIPDM21, the scope of application of the first stage development is being expanded from plural intra-company business divisions to include several external associated companies, and also enhancement of the contents of HIPDM21 is being promoted. The contents of such activities will be described, in particular, with respect to its open data base (DB) and analysis/visualization of its information.

2.2.1 Construction of Open DB

In general, plant engineering activity involves many internal and external divisions and sections which must work concurrently for an extended period of time. Further, since its work sequence is so-called concurrent engineering itself, drafting of product information, its revision and reference thereto are made concurrently in parallel at many sites. For example, it is not seldom that down-stream activities such as 3-dimensional layout work or housing design is performed before completion of P&ID information which determines plant behaviors.

Therefore, in order to proceed the plant engineering activities systematically and in consistency with each other, it is very important for all information to be well coordinated and ensured consistency between respective data bases for enabling data base sharing. Previously, this consistency management is executed on the basis of document, and is not integrated for all design information originating separately. Further, this information consistency management is done manually, thereby taking a lot of time. In order to solve such a problem associated with the manual processing, an open data base for disclosing information regarding respective work status in progress to the internal and external sections involved in the plant engineering is constructed in the second stage of development of HIPDM21, and is now under trial operation for disclosure of typical activity data.

It is intended to disclose information originated in DB at respective sites of activities, to realize N-to-N data exchanges, and store information for analysis for management improvement and as visualization tool. Data originated at respective work sites are stored in the open DB in time-sequence, and compiled into a data structure which is suitable for management of data consistency through batch controls of data versions, data status, data access authorization, references and the like. The data consistency control performed for the open DB is not for completely eliminating inconsistency in design parameters throughout the plant data.

The scope of responsibility of the open DB resides in that each engineer can use with confidence the data he or she wishes to use knowing its data history including when and where it was originated, revised and referenced. The responsibility for excluding any inconsistency in design parameters in the piping system resides on the side of respective piping design divisions.

2.2.2 Analysis and Visualization of Work Progress

Information stored in the open DB is used for analysis and visualization of information useful for improvement of efficiency of plant engineering activities. Presently, R&D’s are under way for the development of means for confirming the status of data revision and its progress during exchange of information between respective divisions, and also means for predicting the scope of extent that may be affected by a data revision in advance.

(1) Sampling of a difference due to data revision

This sampling is made for comparison of respective data versions and statuses by sampling the following differences there between.

* a difference between the prior and present data of open data supplied from work sites,

* a difference in the open data between one' own data base and the others'.

Through these sampling, it becomes possible, for example, to limit one's scope of work to a portion which has been revised and verified, or to assess whether or not the result of one's own activity has been reflected on the other divisions' activities concerned.

(2) Prediction of the scope of data revision

In the plant engineering, a large quantity of data coexists interrelated with each other in many aspects and in parameters. Each inter-data relation may be expressed more explicitly if limited to a particular work activity, however, comprehensive understanding throughout all the activities interrelated becomes difficult. This prediction of the scope of influence due to data revision is contemplated to solve such a problem. It extracts implicit relationship among data on the basis of data history such as data utilization and references, then predicts the scope of extent that any data revision may affect, and assists to improve work efficiency. Its basic experiments are now under way.

3. EXAMPLE OF APPLICATION OF HIPDM21

HIPDM21 is now being applied to actual plants using approximately 350 sets of personal computers and workstations including associated companies. Orientation and instruction courses have been held for participating engineers together with designers and system developers actually involved. Further, "HIPDM21 Implementation Guide" has been published and circulated which was edited not in the usual user's manual format but in a guide book version really useful from the viewpoint of the end users of HIPDM21; for example, "what to do", and "how to solve such and such problems".

3.1 Approach to HIPDM21

Basic approach to HIPDM21 includes two ways of a top-down and a bottom-up. It was applied to actual cases initially of rather small scales, then of larger scales, to build up success on success without departing too far from the end users. HIPDM21 was applied in the following steps.

Step1:Promotion of electronic documentation and electronic filing of information, papers, books and documents related to present work activities,

Step2: Review of work flow and data management systems using the present systems, Step3: Fundamental examination of the current systems and execution of BPR

Now, the statues is in the phase of Step3, and problems associated with HIPDM21 responded from each user are collected, examined and their solutions are being worked out.

3.2 Examples of Application

Examples of application of HIPDM21 will be described in the following.

3.2.1 System Design and 3-dimensional Piping Layout Planning Activity

System design in the upper-most stream of a plant design, Piping & Instrument Design (hereinafter referred to as P&ID) is placed as a basis of design information, and various lists are formulated on the basis of this information diagrams, and it is completed with addition of design data necessary for down-stream design activities such as machine design, piping design, electrical design and so on. Therefore, this P&ID has a role as a logical model of the plant, and all design activities in the down-stream are executed concurrently on the basis of this drawings.

System design engineers and piping design engineers carry out their design works using their engineering workstation (EWS). Data bases of the system design CAD system and the 3-dimensional piping layout planning CAD system are stored in the server on the network. Environments for HIPDM21 are constructed by having programs of PDMACE stored in the server, EWS and personal computers for use in drafting documents and management of administrative activities so as to allow versatile activities to be handled in the same method and manner without need of differentiating between the system design CAD system and applications such as word-processing or the like. For realization of the work linkage, the basic functions of PDMACE are utilized which include a product structure management function, file management function, version management function and viewing management function.

3.2.2 Embedded Hardware/Sleeve Layout Diagram Coordination Activities

Figure 3.1 shows an example applied to embedded hardware/sleeve layout coordination activities. Previously, these coordination activities and their verification and decisions are performed on the basis of paper documents, which were issued, circulated and collected manually. A quantity of such documents is estimated roughly 50,000 sheets of paper (A3 size) per plant. In HIPDM21, a planning division drafts a drawing on graphic CAD, enters its drawing into PDMACE for its management, and uses the workflow function to circulate the drawing to the related divisions. The related divisions who received the circulated drawing, return it to the sender with comments. Figure 3.2 depicts an example of such drawing returned with comments entered. The sender collects all these comments and requests from the addresses, and reflects them on the embedded hardware/sleeve layout diagram.

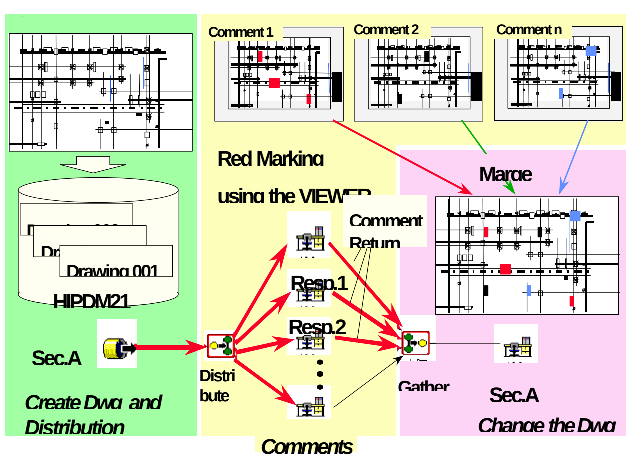

Fig .3.1 Work Procedure

Further, a notification system is used for notifying design changes and so on. This system utilizes the workflow function, and supports activities of drafting of notification, review and approvals, and transmission of drawings and notification.

Through application of HIPDM21, such advantages have been attained that duplicate input of data is prevented, inter-divisional collaboration works have been facilitated, and integrated management of documents and speedy circulation of information have been realized.

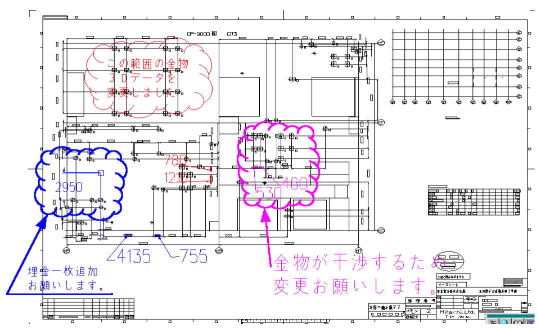

Fig.3.2 Red Marking (Comments)

3.2.3 Component Coordination Activity Using Model Comment Sheet (MCS) in Electronic File

Component coordination activity is conducted by the 3-dimensional plant design CAD model method. Coordination steps are divided into the primary coordination and the secondary coordination. In the primary coordination process, layouts of fundamental components such as housing, equipment, large-sized piping, cable trays, air-conditioning ducts are coordinated. In the secondary coordination step, planning and coordination in details of various support structures, small-diameter piping, instrument piping, power cable piping and so on are carried out. When planning in the primary coordination step is completed, in-house review of all items (entities) related is executed on the basis of the review confirmation sheets, and the results of the review (design contents) are entered into the verification examination sheet. A model comment sheet (MCS) is issued every time a problem arises, and the content of the problem is stored, then reexamination of the layout is executed. After the in-house review and verification examination is completed, it is subjected to external review and examination by customers. When any other problems are anticipated, a customer's model comment sheet is issued for further examination of the layout. Recording of the review was executed on the review confirmation sheet and comment sheet. Status management of reexamination of the layout is executed on the comment sheet management register.

In HIPDM21, documents of the review confirmation sheet and comment sheet which were produced in integrated coordination activities are processed for integrated management using the file management function and version management function of PDMACE. With the file management function, attributes of data such as originator, date of origin are maintained, and the review confirmation sheets and comment sheets are maintained not as mere documents but attached with relevant materials formulated in various formats. Issuance of comment sheet, response thereto, and customer's approval are entered through the workflow.

In the architecture of the work flow, it is not intended completely to conform to conventional hierarchical work system, but is intended to allow concurrent flow of information and data to those who are in charge of verification, approval, examination, and engineers involved in a parallel flat work system in order to shorten the time of information transmittance. Further, in order to cope with such an occasion and prevent delay of work when a person in charge is absent, a group is formed per each activity unit so as to allow reassignment of the work within the group. An example of the work flow is indicated in Fig. 3.5. Through utilization of this work flow, it becomes possible to execute the work status management to the comment sheets, and conventional manual entry into the management registry is reduced.

3.2.4 Piping Stress Analysis and Support Design Activities

Piping systems in a nuclear power plant for which high-level reliability and safety are required are provided with a design support based on structural analysis (piping stress analysis) by computer in order to ensure structural integrity against various stress loading anticipated during plant operation.

The piping stress analysis/design support system includes eleven subsystems corresponding to respective design stages such as a piping stress analysis data auto generator function which determines positions of support fixing and types of fixtures, and produces data for piping stress analysis automatically, a piping stress analysis/evaluation function, and support detailed diagram generator system.

Figure 3.6 shows an example as applied to piping stress analysis activities. This system has a close data linkage with design data (analysis data, drawings) maintained in other data bases of other systems and in the basic system PDMACE. Through utilization of PDMACE, integrated management of design data, drawings and various documents, as well as data consistency check and data status management among various design data have been realized. Further, through utilization of work flows, work activity information exchange (examination and approval of account, drawings and so on) on the basis of electronics data exchange system is realized.

4. CALS APPROACH

4.1 Data Exchange With Power Generation Companies

In the second stage of development of HIPDM21, a system development directed to CALS in linkage with CALS demonstration business activity which is capable of data exchange and sharing with external data bases is under way. In particular, data exchange with customers of electrical power companies is now changing from conventional document-base exchange to electronics data-based exchange.

Table 4.1 shows items of requirements identified as necessary throughout the plant lifecycle as information exchange data. Data exchange demands arise at respective stages of procurement, design, manufacture, construction, test, operation and maintenance.

Hitachi, Ltd. has constructed a common data base to be shared by different companies on the basis of PDM in order to be able to cope with such requirements, and its contents will be described in the following. An outline of this system configuration is indicated in Figure 4.1. It utilizes Internet environments, and is based on the open data base of CITIS. The open data base of CITIS executes product data management and security control using PDMACE. The open data base of CITIS uses the browser of WWW for data exchange.

The structure of the open data base is shown in Figure 4.2, which has a structure of a document information management system for allowing communication with the product information management system of the nuclear power plants. The documents (books) are edited such that they can be filed in document category of design specification, ECS, drawings and so on, and the data format for storing is provided such that all types of data such as text, raster, vector, EDI data can be handled. Document (book) data are linked with the product structure management system to readily allow access and retrieval of the document (book) from respective product structures. In the open data base, document REV management is executed which enables integrated management of disclosed documents. Actual use takes the following sequences.

[Data transmission from Hitachi, Ltd. to electric companies]

(1) store disclosed documents transferred from in-house PDM server in the open data base,

(2) notify the disclosure and document number to the person in charge at the Electric Co. by E-mail,

(3) the person in charge who was notified the disclosure accesses to the disclosed document according to the document number through WWW browser (Figure 4.3 shows an example of WWW browser accessed display).

[Data transmission from Electric Co. to Hitachi, Ltd.]

(1) access to documents at Electric Co. via E-mail or PTP,

(2) register accessed documents in the open data base,

(3) notify Electric Co. completion of its registration in the open data base by E-mail.

A data exchange system for exchanging data between Electric Co. and Hitachi, Ltd. is now being studied at Hitachi, Ltd., however, further discussions are necessary for actual operation regarding such as contents of documents to be stored in the open data base, standardization of document registration systems, linkage with the system of the Electric Co., and so on. In particular, as for CITIS, since it is also under development at Electric Co., a close cooperation and exchange of information between Hitachi and Electric Co. will be needed.

4.2 Data Exchange with Construction Companies

Collaboration with construction companies in engineering activities from concept design to implementation design is required. In particular, with respect to fundamental design and detailed design, mechanical engineering and construction engineering divisions must collaborate together and discuss construction engineering and other related details. Exchanges of design data for such purposes have been conducted on the document basis including drawings and specifications. For improvement in design efficiency, both sides of the mechanical/electrical engineering sectors and the construction sector have been promoting CAD technology, and now it became necessary to collaborate to utilize the results of their respective achievements on CAD systems more effectively.

Therefore, the conventional data exchange on the basis of documents and drawings on paper formats are replaced by electronics data (CAD) exchange according to the following CALS approach, thereby substantially improving the design efficiency as well as design precision. Figure 4.4 is a schematic block diagram indicating this data exchange concept. In the environment of Hitachi's HIPDM21, using open data base/FTP server, and via Internet system, 2 dimensional-to-3 dimensional text CAD data exchange is executed with construction companies.

Contents of data exchange under study and in progress include, for example, in the stage of concept design, information on concrete body forms and frame structures; in the basic design stage, information on deck plate designs; and in the stage of detailed and implementation designs, information on stair steps and monorails, and so on (refer to Table 4.2).

(1) CAD data exchange using intermediate files

In order to realize CAD data exchange as fast as possible, an interface system was developed, which uses an intermediate file specifically developed for facilitating data exchange. This method has such an advantage that since what is required is a conversion program suitable only for a particular CAD system, it is relatively easy to coordinate and formulate data exchange rules and activities suitable for selection of information and data to be exchanged, thereby minimizing the period of development.

Since each conversion program and intermediate file must be developed when connecting with a different CAD system of the customers as shown in the drawing, it is most inconvenient and inefficient when the same data must be exchanged with a plurality of companies having a different CAD system.

(2) CAD data exchange using STEP

Presently, a CAD data exchange method using STEP (Standards for Exchange of Product Model Data) which is CALS standards is being studied in order to improve deficiencies of the intermediate file data exchange method. STEP which is international standards and allows data exchange irrespective of any CAD systems, will become more useful in the future. In the STEP standards, studies directed to AP227 for describing three-dimensional piping, AP225 for describing construction structures and AP230 for describing steel frame works are in progress. As for appropriate methods of data exchange, Hitachi, Ltd. And construction companies will study and develop a conversion program for converting their original files into an intermediate file conforming to STEP standards, and a reverse conversion program therefrom. The schematic diagram is indicated in Figure 4.7. Through data exchange with the construction companies, it becomes possible to improve the overall design efficiency, in particular, reductions of design coordination times, CAD input times and input errors. Further, both rationalization plans for the construction companies and the mechanical/electrical companies can be coordinated in advance so as to formulate an overall plant construction engineering scheme which is integrated and more efficient. The purpose of this approach is to achieve reduction in construction cost, improvement in product quality and speed up of construction.

4.3 Data Exchange With Other Related Companies Located in Foreign Countries

In the global cooperation for plant construction with related companies in foreign countries, more speedy exchange of information such as on engineering, international procurement, operation and maintenance is required. Hitachi, Ltd. is now constructing such a data exchange system which is based on HI-3DM (3-dimensional CAD system) which is a subsystem of HIPDM system, and can exchange 3-dimensional CAD data with related foreign companies such as Bechtel Co. In this construction, a part of the result of NCALS is utilized.

In particular, Hitachi, Ltd. and Bechtel Co. are constructing AP227(spatial configuration model) data exchange system to allow data exchange between two companies as indicated in Figure 4.8. Examples will be described specifically in the sequence of circled numbers in Figure 4.8. Firstly, Bechtel places an order of a plant layout design on Hitachi, Ltd., who acknowledges the order placement on the Internet.

(1) Hitachi, Ltd. carries out a 3-dimensional plant layout design using HI-3DM,

(2) upon completion of the plant layout design, a HI-3DM data is stored in external memory,

(3) this HI-3DM data file is input to HI-3DM-to-AP227 STEP data conversion program,

(4) HI-3DM data is converted to AP227 STEP data,

(5) this converted STEP data is stored in external file,

(6) this AP227 STEP data produced which is in the world standard data format is transmitted to Bechtel using Internet,

(7) Bechtel receives this Hitachi-made external file (CITIS) sent via Internet, and inputs it to AP227-to-Plantspace data conversion program,

(8) stores this converted Plantspace data into external file, then

(9) inputs this data into Bechtel's 3-dimensional layout design CAD system, and

(10) Bechtel verifies the result of Hitachi's design using Plantspace.

In addition to the above, Hitachi, Ltd. is now also engaged in the system construction of AP221 directed to piping design, and AP212 directed to electrical data for enabling STEP data exchange other than AP227. Hitachi, Ltd. is also engaged in projects of AP227 data exchange with other companies such as Dassault, Bentley, CADCENTRE, Jacobus. The results of such projects of AP22U data exchange will be exhibited at CALS EXPOR'97 PCALS Demonstration, Tokyo Big Sites, November 4-7, 1997.

5. CONCLUSION

We have developed the nuclear engineering integrated product information management system HIPDM21, which provides electronics data files including every aspects of information regarding planning, design, manufacture, construction, operation and maintenance of a nuclear power plant throughout its lifecycle, and enables mutual sharing of internal and external information in the environment of PC client server network.

This information management system which is based on PDM, one of CALS technologies (for information sharing), and which carries out precise and complete management of every product information throughout the plant lifecycle not only internally but also externally, for example, including the outside electric companies, construction companies, and vendors of components, has been able to provide for a plant information on-demand environment for providing necessary information to one who needs it at a required site at a required time and on real time. This information management system, therefore, is a computer network integrated system which realizes a concurrent engineering and paper-less business activity environment under respective PC client server network environments.

Hitachi, Ltd. Initiated the development of the first stage HIPDM21 in 1994, completed its development in 1996, and now is applying it to actual plants. Through effective utilization of the HIPDM21 directed to the innovation of plant related activities, remarkable achievements are expected to be attained such as in substantial reduction of lead time in business activities, improvement in efficiency, reduction of cost, and improvement in product quality which have been the initial purposes of this development. Further, we consider it is to be highly appraised as a reliably system that consistency of plant engineering information is maintained by EDCS. In the second stage of the development now initiated, further enhancements of the core systems (PDMACE/EDCS, ICD B, DMS) will be pursued, and also function of respective systems will be upgraded to cope with various issues such as a growing amount of data to be processed resulting from expansion of applications, WWW linkage, intranet, provisions of a prediction function to predict a scope of business activities to be affected by revision in a closely linked business environment and of an instant follow-up function at the time of reshuffle of the organization, and internal/external open DB configuration so as to promote the business activity innovation based on the electronics information. Further, for standardization of CALS (EDI, SGML, STEP), subsystems developed for NCALS, PCALS will be utilized effectively, and a development and coordination of infrastructural technologies required for realization of the electronics information exchange and sharing with the electric power companies, construction companies, related foreign companies, and component vendors are now in progress.

In the future, we wish to contribute to the realization of an integrated CALS technology for inter-business EC standardization through realization of a communication network environment utilizing a large capacity information such as 3-dimensional image data, and construction of a plant integrated dat ware house in the process plant industry.configuration management functions, a version management function, a work flow function, and the like.