

***DNA™ Network Solutions***  
***“Your Key to Information Networking”***

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# **DNA™ *Network Solutions***

## **“Your Key to Information Networking”**

by

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and

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### **Introduction**

Distributed Network Architecture (DNA™) *Network Solutions* have proven to be a cost-effective tool for improving the productivity of end users who make day-to-day decisions for optimizing plant operations. DNA™ *Network Solutions* apply equally well to process and manufacturing industries. DNA™ can access any database or data source to bring information to users throughout the enterprise. DNA™ provides timely and accurate information to employees throughout all levels of a company, i.e., management, engineers, maintenance staff and plant operators, enabling them to make the right decision within the time frame required.

DNA™ has been installed in several information technology applications, providing data to end users, so that mission critical operations and business decisions can be made to increase productivity, lower costs, and maintain regulatory compliance. Arizona Public Service Company, in efforts to improve plant efficiency, embarked upon the Integrated Performance Database and Analysis (IPDAS) project. IPDAS automates centralized storage of information at the Palo Verde Nuclear Generating Station (PVNGS). The IPDAS system relies on client-server technology to optimize plant operations, including, plant performance monitoring, engineering evaluation, and report generation. DNA™ is a principle component of IPDAS, populating the IPDAS data warehouse with near real-time information and providing the glue that integrates the real-time information with the other supplementary static database (test results) information. The DNA™ component of IPDAS is necessary for improved plant maintenance and historical data analysis of equipment at PVNGS.

### **What is DNA™?**

DNA™ was developed for the electric power industry to allow easy, seamless and economic access to "pockets of information" contained in various computer systems and databases throughout a company. DNA™ gathers real-time and static (SQL) information from a wide range of heterogeneous computer systems. It places this data on local and wide area networks, making it available, enterprise-wide, to anyone with a PC and the right security authorization.

Typical systems accessed using DNA™ include: plant process computers at nuclear, fossil and hydro-electric power plants; Energy Management Systems; Emergency Response Facilities Computer Systems; simulators; lower-level real-time information equipment including smart transmitters, remote-terminal-units, and data loggers; and various proprietary and non-proprietary databases on personal computers, minicomputers, hand held units, and corporate mainframes.

The information is available to end user's desktop PCs using the corporation's existing network infrastructure. DNA™ is network independent and operates on top of TCP/IP, Novell®, and Banyan®. DNA™ relies on efficient network communications protocols. In one particular installation DNA™ allows over 20,000 users access to the major computer-based information systems that include in excess of 500,000 data points. Response time for accessing real-time information is less than one (1) second. When this corporation measured the impact of DNA™ on the network they found that it was responsible for less than one (1) percent of the network load.

DNA™ includes several high-level client applications, Enabling Tools (ET) a graphical user interface and EZTrend a trending, analysis and presentation tool, and a powerful general-use pseudo-point processor, the Calculation Service. These applications have access to Structured Query Language (SQL)/ODBC databases. It includes low-level client interface applications like Microsoft® Excel™<sup>1</sup> Add-Ins and an Application Programmers Interface (API) for developers using applications like C/C++, Visual Basic and Power Builder. It also includes a variety of server tools including: the real-time databases that provide global, enterprise access to "pockets of information". A PMAX®<sup>2</sup> Service provides integrated performance monitoring; the (SQL)/ODBC Service allows integration with other systems and databases; the Internet/Intranet/Extranet services for integration of global services; and a Notification Service to automate notification via paging and electronic-mail.

The Services contained in DNA™ include:

<input type="checkbox"/> Calculation Service	<input type="checkbox"/> SQL/ODBC Service
<input type="checkbox"/> Historian Service	<input type="checkbox"/> PMAX® Service
<input type="checkbox"/> Archival Services	<input type="checkbox"/> Internet/Intranet/Extranet Services
<input type="checkbox"/> Notification Service	<input type="checkbox"/> Transient Analysis Service
<input type="checkbox"/> Security Service	<input type="checkbox"/> Time Service
<input type="checkbox"/> Real-Time Service	<input type="checkbox"/> Firewall Service
<input type="checkbox"/> Global Naming Service	<input type="checkbox"/> Alarm Service
<input type="checkbox"/> Application Service	<input type="checkbox"/> Programmer Kit (SDK)

**Table 1: DNA™ Services**

<sup>1</sup> Excel™ and Word™ are a registered trademarks of Microsoft Corporation, Redmond, WA.

<sup>2</sup> PMAX™ is a registered trademark of Scientech Corporation, Idaho Falls, ID

## The PVNGS DNA™ Application

A major deliverable of the PVNGS Integrated Performance Database and Analysis System (IPDAS) system project was the Industrial Peer-To-Peer, Inc. (Ip<sup>2</sup>) Distributed Network Architecture (DNA™) Network Solutions Software. This Software accesses the real-time Emergency Response Facility Data and Display System (ERFDADS) and Plant Monitoring System (PMS) data (e.g., pressures, temperatures, flows, etc.) for each of the three PVNGS units, and stores this information in a separate proprietary database (Historian) for each plant unit on a DNA™ server, running Windows NT™<sup>3</sup>. The data on the DNA™ servers are available to PVNGS plant personnel through the Palo Verde Information System (PVIS) and other APS personnel located off-site through the corporate information network. There is minimal impact to ERFDADS and PMS and less than 2% additional loading to the networks communicating the data.

Plant, Reactor, and Systems Engineering are able to conduct trends and analyses on plant components (condenser, RCS, etc.) in near real-time resulting in potential improvements in equipment and plant operation. Maintenance staff use the real-time information to conduct condition monitoring of components and systems for reliability centered maintenance programs, as well as input into the Maintenance Rule.

There are four dual Pentium servers running Windows NT™ that support this application installed on the PVNGS network. There are 4096 digital and 4096 analog points for ERFDADS, and 5000 digital and 5000 analog for PMS per plant unit.

The DNA™ applications are currently 16 and 32 bit programs that will execute on Windows for Work Groups™, Windows 95™ and Windows NT™. DNA™ will run on any 486 client machine or better, which all of PVNGS personnel have. Any workstation (Windows 3.1.x, Windows 95™ or Windows NT™) is able to access the data through the tools provided with the DNA™ product. Any printer on the Local Area Network (LAN) can print a DNA™ report.

Authorized PVNGS users can install DNA™ from their desktop. There is an APS install menu whereby the user installs DNA™ in much the same way he/she would install Microsoft Word™. The installation process takes about two minutes and requires no special configuration activation.

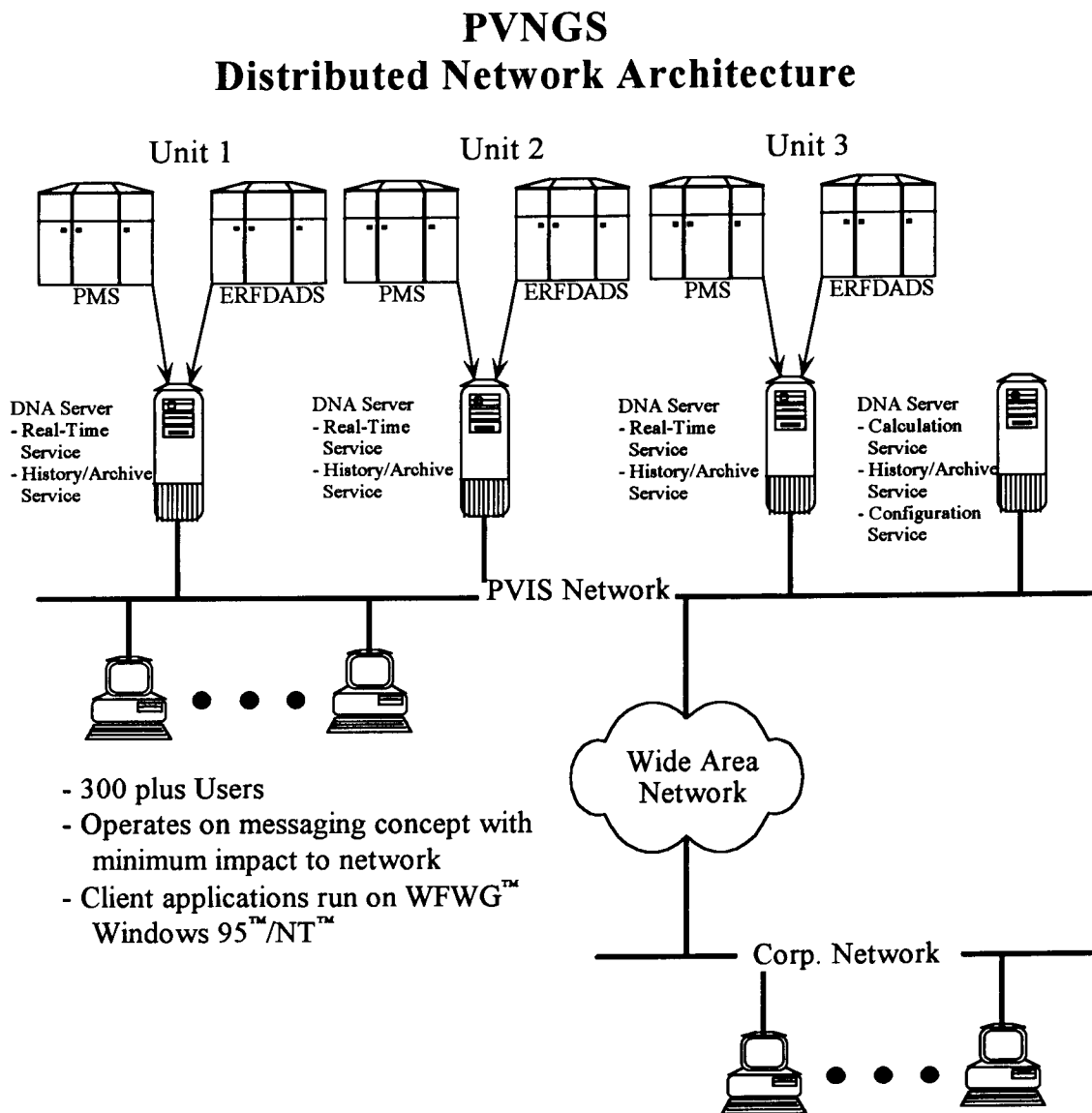
DNA™ hardware and software have been in production since September 17, 1996. There have been no major problems with the system. The only down time occurred early and has been due to hardware problems, e.g., disk failures or inadequate power conditioning.

There are approximately 200 to 300 users (and increasing) who have access to this data throughout PVNGS. Most of the users are engineering users, accessing the DNA™ servers from the Engineering Building and the Maintenance Engineering facilities. The remaining users are located in the plant operations and maintenance areas and corporate offices located in Phoenix. There are expected to be a maximum of 20 concurrent users accessing this data. The number of concurrent users will not be a problem since the system is designed so that each user does not establish a session, i.e., DNA™ functions on a messaging concept.

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<sup>3</sup> WFWG, Windows 95 and NT are registered trademarks of Microsoft Corporation, Redmond, WA.

The following diagram shows the overall system design and interfaces:



**Figure 1: DNA™ Implementation at Palo Verde Nuclear Generating Station**

Administratively, the Operations Computer System (OCS) Department, which supports the plant process computers, is responsible for maintaining the DNA™ applications and NT™ operating system. This decision was made primarily because of recognition that the control of the process systems was a number one priority; consequently, any changes involving the operation of the DNA™ application is made by OCS. However, it was recognized that the NT™ servers are on the PVIS network, and that close communication between the two groups is essential for successful operation and support. This relationship has been very strong, and has worked very well.

Recovery

Currently, if any part of the system goes down for some reason, then each program owner is responsible for supplying the missing data. The data can be obtained from the ERFDADS history which is a 16 day circular history file. This process is controlled by OCS.

Down Time

The target duration for an unplanned outage is less than eight (8) hours. This includes problem correction, system files recovery and data base file recovery.

The system has been designed to minimize unplanned outages. Dual Pentium servers use mirrored disks to avoid outages caused by disk problems and are based on standard hardware making system replacement timely. The redundant processors and mirrored disks should mitigate downtime, and inability to collect data for an extended period, which can be detrimental to analyzing plant conditions.

Data Loss

Data loss should be minimized since the only updating to the database during normal operation is through the ERFDADS to DNA™ transfer process through R\*TIME®. There should be no loss of data prior to the start of the failure. Transactions in process (block data transfer) during the failure may be lost, but are manually recoverable from ERFDADS. In the case of a PVNGS network disaster, data generated since the last backup may be lost.

The following hardware was installed per OCS procedures:

<ul style="list-style-type: none"> <li>• Operating System</li> </ul>	<ul style="list-style-type: none"> <li>• Windows NT™ 3.5 for each of the four servers configured per APS standards</li> </ul>
<ul style="list-style-type: none"> <li>• Disk Mirroring System</li> </ul>	<ul style="list-style-type: none"> <li>• Windows NT™ disk mirroring, used to minimize data loss, and facilitate backups</li> </ul>
<ul style="list-style-type: none"> <li>• Hardware Configuration (Plant Unit Specific Servers)</li> </ul>	<ul style="list-style-type: none"> <li>• Dual 120 MHz Pentium Processors</li> <li>• 64 MB RAM</li> <li>• Six(6) 2 GB hard drives(3 mirrored)</li> <li>• Fast SCSI Controller</li> <li>• One 3.5" Floppy drive</li> <li>• One CD ROM</li> <li>• One DAT Backup</li> <li>• Enhanced Video Graphics Display</li> <li>• Two Serial; One Parallel Ports</li> </ul>
<ul style="list-style-type: none"> <li>• Hardware Configuration (Administrative Server)</li> </ul>	<ul style="list-style-type: none"> <li>• Dual 120 MHz Pentium Processor</li> <li>• 32 MB RM</li> <li>• Two(2) 2 GB hard drives</li> <li>• Fast SCSI Controller</li> <li>• One 3.5" Floppy drive</li> <li>• One CD ROM</li> <li>• One DAT Backup</li> <li>• Enhanced Video Graphics Display</li> <li>• Two Serial; One Parallel Ports</li> </ul>

**Table 2: DNA™ Hardware Installed at PVNGS**

## **PMAX® Thermal Performance Monitoring**

Plant process data attendant to thermal performance monitoring is acquired by DNA™ and fed into the PMAX thermal performance calculation algorithms integrated with DNA™. Real-time data scanned at rates specific to the performance parameters desired, are accessed and placed into a Current Value Table for further processing. Minimum, maximum and averaging of the data can be accomplished prior to accessing by PMAX's calculation engine. Thermal performance information unique to the plant, its systems, and related component's can be readily displayed on DNA™'s EZTrend or Enabling Tools Man-Machine Interface.

PMAX is being installed on ERFDADS at PVNGS and will be accessed by DNA™.

## **What is the Business Case for DNA™?**

Over the past several years, process industries have begun a shift towards deregulation and increased competition. Responding to these changes, these industries have begun to update network Information Technology (IT), and apply new IT solutions in more effective ways. This investment in network IT enables businesses to gain the most from the existing infrastructure and planned system improvements, and to establish enhanced data analysis and management methods that allow more productive business processes and profitable decisions. Plant process information is provided on user desktops and readily integrated into standard decision tools that traditionally has required significant investment of time and resources to obtain. The resultant benefit is readily seen in productivity gains and reduced costs as demonstrated by real improvements in the "bottom" line.

The integration of DNA™ enables companies to break down the traditional barriers within the organization to perform information and data sharing more effectively. DNA™ provides the tools to facilitate gathering, collecting, recording, storing, archiving, manipulating, displaying, and analyzing the results of plant operations and business data, thus enabling the elimination of process steps, the enforcement of standards, the automation of record-keeping, and notification. DNA™ is network-driven and provides information to end users allowing them to make the correct decision. It is a key aspect of any real-time data implementation strategy.

Specific experiences at a power plant include:

- Productivity improvement in preparing reports resulting in cost reductions of \$81,000 annually.
- Elimination of mainframe maintenance costs of \$37,000 annually.
- In-service inspection and surveillance testing reduction and efficiency improvement of \$50,000 annually.
- Reductions in cost and duration of outages (planned) for maintenance through the optimization and elimination of Preventive Maintenance (PM) work and instantaneous availability of plant systems status.
- Increased worker efficiency and productivity from 5% to 10% overall.
- Reduction in the number of forced outages.
- Reduction in fuel costs due to increased efficiency and equipment/plant availability.
- Improvement in reliability of systems.

Additional DNA™ benefits include:

- ❑ *Maintenance Programs:* DNA™ provides real-time data for the optimization of maintenance programs for the reduction of O&M costs. This is accomplished with systematic programs (i.e., Reliability Centered Maintenance, Risk Based Inspection, etc.) incorporating condition-based monitoring and inspection to replace current preventive maintenance activities. Enhancing predictive maintenance is accomplished via automation of maintenance activities and condition monitoring. O&M budget expenditures have been optimized by: maximizing unit availability, implementing value upgrades and equipment life extension, minimizing PM expenditures, and minimizing risks due to significant outages, casualty and property losses.
- ❑ *Regulatory/Industry Reporting:* Automating real-time data for Maintenance Rule and other reporting, e.g., Nuclear Plant Reliability Data System (NPRDS).
- ❑ *Asset Management:* DNA™ acquired data provides input into financial decision programs, reliability programs for optimization and planning, equipment life extension, , etc.
- ❑ *Productivity Improvement:* Data gathering/display/collaboration, API's to third party applications: Microsoft Excel, SQL Programs (Oracle, Sybase, Access, etc.), export/import to PowerBuilder, Visual Basic, Access, etc. resulting in an IT dissemination cost savings of 30-50%; and allows for the elimination of redundant dissemination systems.
- ❑ *Performance Monitoring:* System and operation engineers use DNA™ for real-time and off-line analysis of equipment data, including thermal performance, thermography, and vibration monitoring. Data is acquired from heterogeneous plant process computer systems for equipment run-times, surveillance testing, and problem analysis.
- ❑ *Transient Analysis:* Reactor and energy management engineers use DNA™'s transient service to analyze events in a high resolution mode of historical data following a system 'trip' and validate computer models.
- ❑ *Obsolete Equipment Replacement:* DNA™ allows the use of-the-off-shelf PC monitors to replace costly and obsolete terminals.
- ❑ *A study by International Data Corp.* Framingham, MA, found that for every dollar spent on network solutions implementation yielded ten dollars in combined saving and productivity. Training costs were low. Payback periods ranging of 6-12 weeks were typical suggesting that the risk is low.



### Indefinite Benefits

Companies using DNA™ reported a number of indefinite benefits as a result of using the Software. In all cases, these benefits were significant and formed the basis for success in achieving the financial benefits projected.

Salient findings include:

- improvement in employee morale,
- elimination of duplicate databases,
- improved accuracy of information,
- improvement in communications between engineering, maintenance and operations departments,
- improved performance measurement, and
- improvement in customer service.

### Summary

DNA™ Network Solutions have been designed to enable process and manufacturing industries to cope with competition in the face of changing regulation. Its integrated, enterprise-wide design provides functionality to facilitate the presentation of data and population of data warehouses, thus improving the efficiency of business and plant operations. Input from APS and other customers of the Software confirms that DNA™ provides real and consistent value to companies that implement the Software and use it in concert with existing applications to enhanced business operations.

The advantages of DNA™ include:

- minimum impact on network loading: typically less than 2%,
- network speed: less than one (1) second user response to real-time data requests,
- true client-server architecture: minimum enterprise client hardware required (Intel 386, 20 MHz are higher),
- payback of less than one year in most installations,
- applications functionality and compatibility with heterogeneous computer systems and databases,
- ease of installation and administration: advanced tools, and
- ease of use: complete training in less than one week.

The business case received from the use of DNA™ Network Solutions is discernible in hard dollars and key examples of system benefits have been established to provide its value. DNA™ is now a well documented, mature yet evolving application, with user support and references.

DNA™ is being used by Pacific Gas & Electric, Southern California Edison, Arizona Public Service Co., City and County of San Francisco, and by UNOCAL. DNA™ affords productive presentation of real-time and/or historical data on plant equipment with access to SQL databases, no matter where this data resides, to provide decision support to end users.

## About the Authors

### Patrick Fahey

Pat is Vice President and General Manager of Industrial Peer-to-Peer, (Ip<sup>2</sup>). He also manages projects for Ip<sup>2</sup> out of their offices in Arroyo Grande, CA. As Supervisor, Special Projects (Computer Engineering) for Pacific Gas and Electric Company, Pat managed the development staff of programmers and engineers and was Project Manager for the Nuclear Plant Process Computer replacement at Diablo Canyon Nuclear Plant. Pat has been a Senior Systems Analyst involved with the operation and maintenance of several plant process computers, and was a member of team that brought the first wide area networks to PG&E in 1986. He has developed network-based solutions for operations and engineering at several companies and was the Computer Systems Supervisor at the LOTT Facility for the City of Olympia, Olympia, WA.

Pat has a BS in Computer Science, majoring in Artificial Intelligence from The Evergreen State College, Olympia, WA, and is currently pursuing an MBA in Technology Management.

### Robert E. Holzworth

Bob is Vice President of Sales & Marketing for Industrial Peer-to-Peer, residing in Idaho Falls, ID. He has approximately 20 years in the electric power industry in varying capacities from project and program manager to VP of Regional Operations. Prior to joining Ip<sup>2</sup>, Bob managed the southeastern regional operations for The Indus Group, who are a key provider of business process systems and software for the process industries.

Bob has managed several computer systems projects for EG&G, Idaho, Inc. and started his business development career with EI International, in Idaho Falls, ID. Additionally, he has designed propulsion systems for eleven years with Martin Marietta Corporation on the SkyLab and Shuttle Programs.

Bob has a BS in Mechanical Engineering.

### Ray J. Webb

Ray has been with Arizona Public Service almost 20 years in the Information Technology Department. Half of this time he has been a developer for engineering and scientific applications. The other half as a supervisor managing software development, maintenance, and support for the Engineering Department. The last seven years have been in support of Palo Verde Nuclear Generating Station. Recently Ray managed the client-server development projects for Dosimetry, IPDAS (Integrated Performance Database and Analysis System), and Chemistry.

Ray has a BS in Mathematics and a MS in Nuclear Engineering