

## **A NEW ADVANCED SOFTWARE PLATFORM FOR NUCLEAR POWER PLANT PROCESS INFORMATION SYSTEMS**

**Aimo Sorsa  
ABB Strömberg Power Ltd.  
Control Systems Division  
Helsinki  
Finland**

### **I. Introduction**

The functions of a nuclear power plant process information system (PIS) have in the past been realized by a deluge of independent, specialized systems dedicated to specific needs like plant performance monitoring, NSSS monitoring, critical function monitoring, etc. In many cases these systems have not been able to pass information to other systems or communicate between themselves. Each of the systems has normally its own "look and feel" for user communication and requires its own separate computer and user interface equipment.

The recent rapid progress in computer technology has offered a good basis to more integrated process information systems which provide better management at lower procurement and maintenance costs.

A modern software platform for an integrated nuclear power plant PIS should meet the following requirements:

- o high real-time performance in data scanning, display updating, event processing, etc.**
- o high availability, flexible back-up schemes, and on-line resource allocation capability**
- o easy expandability with new applications and interfaces to other systems**
- o conformance to international standards (ISO, OSI, OSF)**
- o utilization of standard commercially available hardware**
- o versatile functions for standard preprocessing, data storage and presentation**
- o user friendly interactions and data presentation for multiple user groups (operators, plant management, etc.)**
- o flexible easy to expand hardware configuration according to plant specific requirements.**

## **II. Highlights of New Platform**

**ABB Strömberg Power Ltd. started in the late 80s the development of a new generation software platform for power plant PIS. This development resulted in a software platform called Procontrol PMS. Procontrol PMS is a platform for fully distributed systems, which provides the following features:**

- o Distributed data processing - All computers and workstations are linked together in a highly efficient manner to provide logical function nodes. These nodes work co-operatively, with very little overhead, to provide cost-effective high processing capabilities.**
- o Non-stop architecture - Software functions reside on logical nodes within the computer complex and all the functions, which are critical for plant operation are automatically restarted on designated back-up nodes when primary resources are unavailable. This results in a high availability, with a fraction of the unused processing power required by traditional systems based on a redundant configuration (hot stand-by). Also several kind of reduced mode operations are possible in most failure cases.**
- o Low-cost incremental expansion path - Nodes can be added on-line at any time to increase power and/or functionality. The engineering labor associated with the system reconfiguration is minor.**
- o Open network architecture - The Ethernet/DECNET environment applied by Procontrol PMS allows for easy addition of alien systems and application software packages to the system. All the information of the Procontrol PMS network database is available in every node of the system.**
- o High functionality - A versatile set of standard easy to use services is available for process information management.**
- o Effective application development environment - A set of interactive tools (PMS-TOOLBOX) is provided to define and maintain the system configuration, database, operations, displays, and reports. All tools are available for on-line use in the target system itself. There is no need for any dedicated development systems.**
- o Advanced user interface services - A wide range of man-machine -devices like X-Windows workstations, PC's, postscript printers, ASCII terminals, etc. are supported. Special features like windowing, zooming, panning, and decluttering are also available depending on display hardware capabilities.**

### III

#### Structural Description of New Platform

Procontrol PMS software is organized into three levels:

1. PMS-KERNEL
2. PMS-SERVICES
3. Optional Application Packages

In Figure 1 the center circle represents the PMS-KERNEL, with satellite sectors representing the PMS-SERVICES and interface with Optional Application Packages.

The PMS-KERNEL unifies the system into 'one big computer' for each software process irrespective of the actual hardware configuration. Figure 2 shows the principle of distribution for a PIS utilizing Procontrol PMS.

The PMS-KERNEL consists of:

1. Network Operating System
2. Network Data Base
3. Application Development Environment.

Standard methods and interfaces are provided to integrate the PMS SERVICES and other programs with the PMS-KERNEL.

The PMS-SERVICES include a wide range of facilities for process monitoring and control. The PMS-SERVICES realize all the standard functions of Procontrol PMS. Their application dependent features are defined by the PMS-TOOLBOX. The Services are connected to each other via the PMS-KERNEL. The available standard services appear from Fig. 1. Additionally, a standard interface is available for interfacing a Procontrol PMS based PIS with simulation computer systems of training simulators.

### IV

#### Applications of New Platform

ABB has received by May 1992 six orders for nuclear power plant PISs based on Procontrol PMS. Four of them are for PWR plants the remaining two being for BWR plants.

The first Procontrol PMS based nuclear power plant PIS was commissioned in 1989 at Loviisa nuclear power plant in Finland and has been running with 100 % availability since the commissioning. The user experiences during this operation period have been extremely positive. Especially, the performance of the new PIS during plant transients and its advanced data presentation features have received good response from the plant operators.

The remaining five orders are under implementation. They are for Olkiluoto BWR in Finland, Krško PWR plant in Slovenia, and three plants in the USA (Brunswick BWR plant, Vogtle and Palisades PWR plants). The Olkiluoto and Krško PISs are being commissioned (in May 1992).

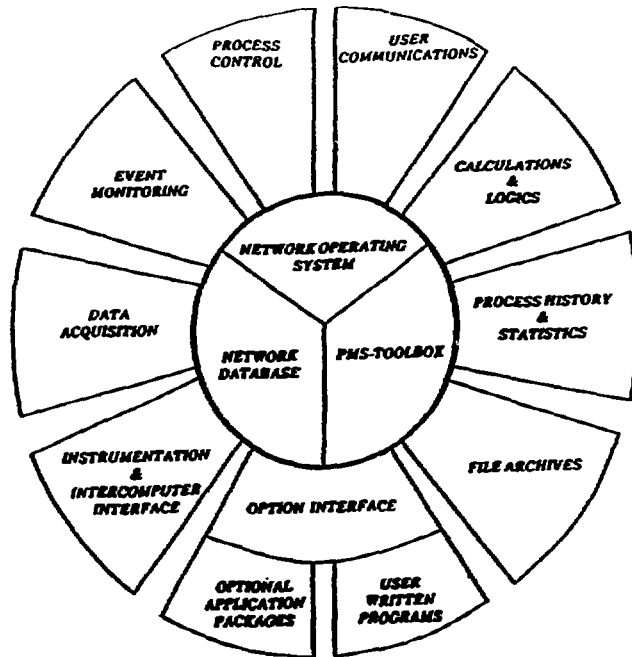


Fig. 1: Procontrol PMS Structure

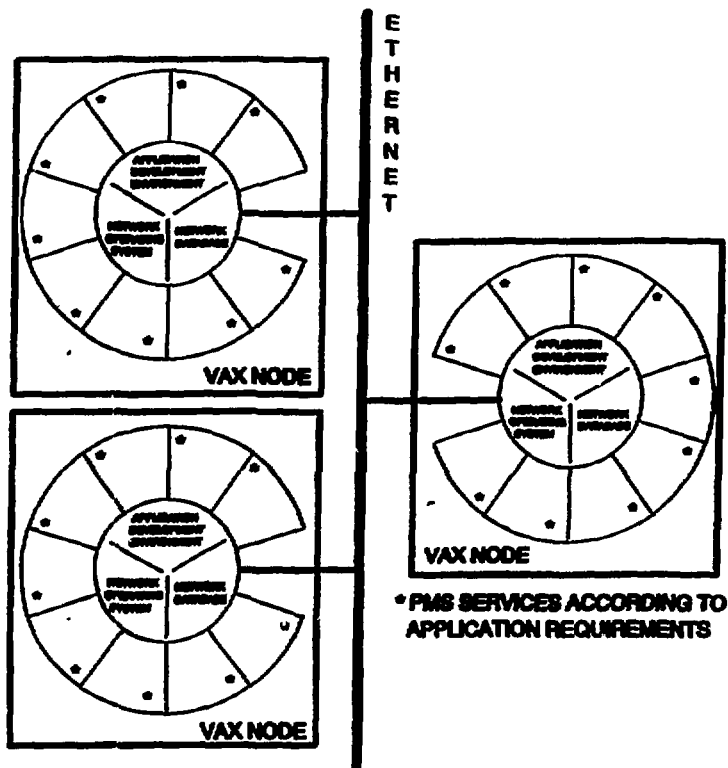


Fig. 2: Distribution of Procontrol PMS Based Process Information Systems