IEC61131 – A USERS' PERSPECTIVE FROM INNOGY

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Why IEC61131?

In the early 1990's National Power decided to carry out a series of control system refurbishments on coal-fired power plants post-privatisation. A major review of the commercial systems that were available from control system vendors was undertaken. The company was looking for systems that adopted open standards to enable integration of existing systems and to avoid being tied into particular suppliers and their equipment. The belief was that this would keep down the overall cost of the systems, and reduce long-term maintenance and engineering costs. The outcome of the review was that there was no major DCS that was found to be totally open, as they all had some proprietary systems. Consequently, the company decided to produce a functional specification and system architecture design based on open standards that would provide a suitable platform for future control systems needs.

For the operator information and control interface, APMS was subsequently developed from the Syseca product OpenPMS based on Agilents (formerly Hewlett-Packard) Rtap Product. This runs on commercially available computer hardware and communicates to other control products using the Ethernet standard protocol. Whilst for the control system, the adoption of the IEC61131-3 standard for the programmable control processors was a fundamental part of the requirements. This meant that in assessing potential process control systems available from different vendors, National Power sought some degree of compliance with IEC61131-3. An overview of the system architecture is shown in Figure 1.

What did IEC61131 mean to us?

Future process control system support was likely to continue to involve working on different systems both within sites and at different sites. It was in our interests therefore to utilise systems based on common standards, to enable the transition between products to be as smooth as possible in order to maintain staff productivity. Where work is externally resourced, the use of common standards would widen the contracting resources available for application development and implementation. There was also a desire to be able to implement applications developed on one station, across other stations where they were deemed to be of use, ideally, this would be through the ability to transfer code from one system to another.

System Selection

The criteria for selecting a system included dual redundant hardware with support for communicating to external systems using Ethernet and Modbus standard communication protocols.

The programming tool for software configuration was to include the IEC61131 languages ladder logic, function block, structured text and sequential function chart. The reason for this selection was that each language ideally suits the programming of different control functionality. Ladder logic being the language for implementing interlocking, function block

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for modulating control, structured text for mathematical functions and use of program loops and sequential function chart for managing sequences.

In reviewing systems advertising IEC61131 compliance, it became clear that the systems did not give any indication of the degree of compliance, whether in terms of languages offered or the degree of implementation of each language. National Power found that choice was limited in terms of the systems that were considered to offer the extent of compliance that was sought.

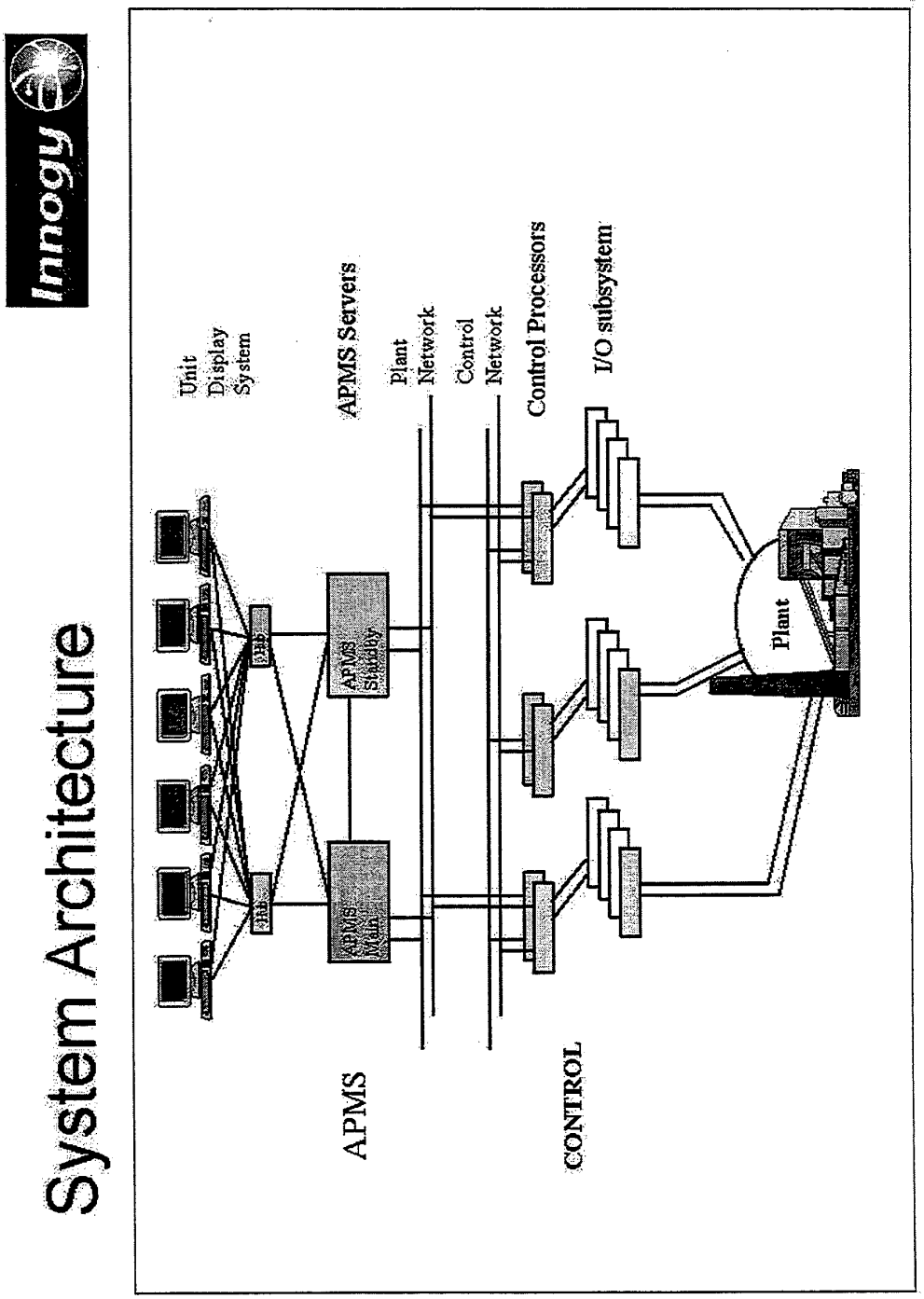

Figure 1 Overview of System Architecture

System Implementation

Innogy now has two different vendor-supplied systems installed at different sites. One system implemented in Moore APACS includes the complete modulating and sequence control of a dual coal and gas fired 500MW unit. The fuel oil system at another site is implemented using

RTP 2200. The differences between the two installations are the overall system size, and the extent of the equipment user base within the UK.

Where sites look to replace or add new processors there are issues to be addressed. The first is the change in hardware which results in the need for an increased spares holding and maintenance knowledge. The second is the configuration software training and support requirements. Where staff numbers have been reduced, user friendliness plays a large factor in the appeal of a system. This is just as important in a system that is accessed infrequently as in one that may be constantly used. Where the functionality of software of systems from different suppliers follow a common standard sites are more likely to accept different systems on site. The final issue is the robustness of intersystem communications which is at present usually implementated by the use of modbus. Where this is not considered suitable hardwired signals have to be utilised, should this be the case in a truly open system?

Application Development

One particular standard application developed by Innogy and intended for implementation on multiple sites and systems was defined using the IEC61131 standard. The definition was done primarily using structured text as this was the most flexible language from which all function blocks can be defined. This application has now been implemented both using the old CEGB developed CUTLASS language and within an IEC1131 based controller. Within the IEC1131 controller it was desirable to do as much of the implementation as possible within function block – the preferred language for modulating control and where the on line variable display facilities often make testing and commissioning easier. This conversion to function block depends on the standard functionality on offer and further function blocks have to be developed using the structured text language.

Having completed one application in one IEC61131 controller we are now in the position where we are considering the move to equipment supplied by a different supplier. There is currently no immediate prospect of import and export tools and so the reality is the code will have to be re-written. The amount of work involved will depend not just on the function block availability and behaviour between the different systems but also on the organisation and nesting structures that the configuration software permits.

Further Issues

We still see one of the main problems being the level of implementation of the standard offered by different systems. There still seems to be a long way to go from base level compliance on ladder logic, instruction list and perhaps sequential function chart to full implementation including task control. There are ways to engineer solutions to each problem but the solution is not currently the same for each system and therefore the full benefits of the standard are still a long way off.

We would also like to see more work on the standard function block implementations. Only a few basic functions and function block definitions and examples are given within IEC 61131-3 with reference made to other function standards (IEC 60617-13). From our experiences we feel that more benefit could be gained by extending the scope of the function block definitions provided and also required by the standard.

IEC61131 defines programme structure and behaviour. Thus, we have defined basic block functionality and behaviour. Extending this defined functionality is user code. The basic blocks are grouped together to provide reusable blocks with a higher level of application functionality. It is one area where the programmable controller languages may differ from

functionality provided by the major DCS vendors. Rather than utilising standard higher level function blocks the designer is required to make available to the engineer the functionality to suit individual user requirements. In this area good discipline and coding standards are required to produce high standard code and reusable program units.

In summary, we believe that we are a long way from achieving the full benefits of a common standard. As more systems extend their implementations towards IEC61131 more long term engineering benefits will be achievable. This will be both in terms of the transfer of engineering skills and for porting of applications between systems.