

# Comparison of a Single-loop Digital Controller to a DeltaV Multi-loop Controller

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## Introduction

Plant expansion and upgrade projects frequently use subsystems that include not only the basic equipment, but that include “standard” controls associated with this equipment. Boilers are a good example where the vendor’s choice of peripheral equipment is often used without question. However, a number of questions should be asked about the new equipment’s controls, especially when funding and capability are being reviewed. Sometimes the equipment supplier quotes controls they find acceptable to the buyer, but more often they provide their “standard” brand of systems. These “standard” controls may include single-loop controllers. This paper is based on one such experience where a well-known boiler manufacturer proposed single-loop controllers for use with three boilers in a grass-roots powerhouse.

From a perspective standpoint, it is perhaps worth noting that when any vendor bids on a project, they often offer the minimum system to improve their chances of winning the project. It is not necessarily what they would use in different circumstances, but it will meet minimum requirements. Considering the total installed cost of the boiler, it is certainly desirable to contain costs, but cutting corners with the controls is unlikely to save much on capital and will add hidden costs down the road during operation.

In discussions with several people knowledgeable about the boiler supplier, including one of their customers, it seems that this supplier often proposes a well known brand of single-loop controllers (SLC) through a third party, an engineering company. The new boiler’s standard control system usually includes four SLCs, a panel board, chart recorder, and annunciator. The estimated price is \$30K per boiler for these systems. In considering the extensive additional capabilities of a multi-loop controller like the DeltaV™ controller, the difference in cost is probably not significant between the two and, with redundancy; the DeltaV controller might even be less expensive. If the purchaser added in the cost for additional capabilities already provided by the DeltaV system, cost would no longer be an issue.

## Contrasting Single/Dual-loop Controllers with the DeltaV System

### Control Capability

Most of today’s single- or dual-loop microprocessor based controllers are very capable from a computational viewpoint. Considering the experience of Nebraska and their engineering subcontractors, these controllers will likely do a good job for continuous control of the boiler. At a minimum, these controllers need to have capabilities for not only PID, but also some capability for calculations, velocity limiting, and lead/lag.

One question to consider is have they included logic that handles failures or abnormal events? For example, the DeltaV system checks the validity of inputs on every scan. If a bad input is detected on a loop, that loop is placed in manual mode. Likewise, the mode of certain loops used for cross-limiting air and fuel are continually monitored and mistakes by the operator are overridden. It is unlikely that the dual loop controller has the memory or resources for all this checking and protection for the operators. All this additional checking lowers the customer cost or consequences in failures. It results in graceful degradation for failures of inputs and avoids operator mistakes that can upset the plant at crucial times.

### Dual-loop Controllers Provide no Redundancy

**Single/dual-loop controllers lack event and history recording:** The DeltaV system includes an event chronicle to record changes in operation, failures, and system events. This history is critical to determining what caused boiler trips, outages, or failures. With single- or dual-loop controllers, there is typically no way to see if events were caused by problems with equipment, controls, or operator errors.

Most single-loop boiler control systems must include chart recorders for a few key continuous measurements that are used for environmental records. Their secondary use is for diagnosing problems. However, these are so limited that they often do not tell much about what happened and when. Charts also consume expensive paper unless they are of the modern microprocessor type, and if they need to be repaired, it would be preferable to replace them. For comparison, the DeltaV system comes with a real historical trend collection system that records not only typical measurements, but calculated values as well. The number of variables that can be collected and stored is enormous with the DeltaV system. These data are saved in a Microsoft Access™ database and can be exported to Microsoft Excel or Word for reports.

**Today's single-loop controllers do not interface with smart field devices:** No single-loop controllers are known today that interface with smart devices using either HART or fieldbus communications. Because the DeltaV system incorporates this technology, the cost for startup, maintenance, and engineering is reduced to a minimum. For example, if fieldbus instrumentation were to be used, wiring costs could be reduced 80 to 90% on new installations. With digital valve controllers, the positioner can be used to verify that actual valve positions match those being requested or an alert is issued to indicate mismatches. Considering that the majority of control problems are related to field devices, the potential for longer-term better control and reduced maintenance cost can be realized. Requiring that the control system be capable of interfacing to smart field devices will save new projects cost and reduce longer-term maintenance.

**The DeltaV system is easier to configure and diagnose:** Many of the single- or dual-loop controllers have unique configuration languages. These often include table structures with instruction codes and operands that are difficult to understand and maintain. Many integrators have a lot of experience with these, but it's unlikely that someone with the right skills and knowledge is going to be quickly available after startup is over. Make sure that if single-loop controls are used, they come with a high-level programming language that is easy to understand and modify. If a high level editor is used, then it should be compliant with international standards.

The DeltaV system, on the other hand, comes with a high level, programming interface that works in the Microsoft Windows environment. The basic blocks were designed with conformance with Foundation fieldbus standards. The language is graphical and can be audited on-line in real time.

Diagnostics is another defining issue. With the DeltaV system, the diagnostics can tell you not only about the device performance and loading but also about its hardware and software revision levels.

## The Human Machine Interface on Single/Dual-loop Controllers

Obviously, the interface on single or dual loops is minimal. One of the problems people fail to note is that on dualloop controllers, you can see only one loop, or trend, or alarm at a time. This is not much help in a plant upset. That is why it is usually necessary to include an alarm annunciation panel or other special monitoring system.

When things are upset, the operator needs access to outputs and inputs quickly and without making mistakes. If fuel and air are in the same controller this is going to be difficult. Even if they are in separate controllers, it is going to be awkward.

Ever try entering numbers on the small systems when you're in a hurry? It's too easy to make a mistake that can cost a lot.

If you have seen the interface on the DeltaV system, it's clear that much more information is available. Also, changes can be made more quickly and accurately with drag-and-drop.

## Information Integration Capability

Some of the single-/dual-loop systems have add-on communications capabilities with other systems and plant information systems, but this really depends on the vendor. However, the customer needs to ask what kinds of devices are required to make the connection and the effort to make the communications? These are often unique, and have limited ability to transfer key information.

The DeltaV system was designed for use with plant information systems. For example, the integration stations are designed for interfacing with plant networks while workstations are directly compatible with Microsoft Excel.

Overall, customers should take a close look at small systems that are unique, have lots of wiring required, and are not compatible with today's standards. If the total cost is looked at, the DeltaV system is going to be the lowest cost system by far.

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