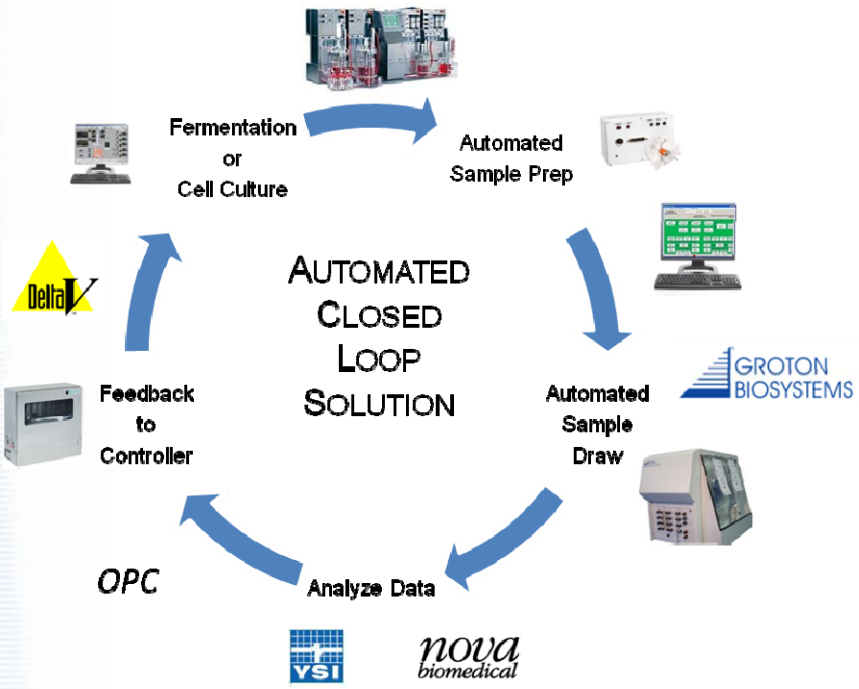
TECHNICAL NOTE

AUTOMATED REACTOR SAMPLING (ARS™) SYSTEM INTEGRATES SEAMLESSLY TO DELTAV™

REDUCING OPERATING COSTS - IMPROVING PROCESS QUALITY AND RELIABILITY

Automated Reactor Sampling (ARS) System solutions from Groton Biosystems have been designed for seamless integration with an array of bioprocess control platforms. Integration of these platforms, (whether by ASCII or OPC technology) to the ARS can deliver improved process quality and reliability while reducing operating costs. For the purpose of this technical note the focus will be on the integration of the ARS to the industry leading DeltaV Bioprocess Controller and the realized benefits from this integration.



As illustrated in Figure 1, the DeltaV Controller architecture is that of a Distributed Control System (DCS). The benefits of a DCS solution include the following:

In the event of a PC failure there is NO IMPACT on the process being controlled since control is accomplished in the Controller - not the PC.

1) Any PC on the DeltaV network can be used to monitor and/or control any device on the network.

2) The DeltaV Controller is OPC (Ole for Process Control) enabled for the role of either Client or Server and supports the industry leading digital protocols of HART®, Foundation™ Fieldbus™, DeviceNet™ and Profibus.

Figure 1

This is in contrast to the older SCADA and proprietary architectures which greatly limit network flexibility, experience issues of robustness and do not support the use of OPC or digital protocols.

The role of the DeltaV Controller is to monitor incoming process data and when necessary implement changes in the process control strategy by

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changing process outputs. Traditionally, this role has involved the DeltaV Controller in monitoring process measurements from in-situ sensors such as pH, dissolved oxygen, temperature and conductivity. These sensors would provide the Controller with the measurement data it needed to make adjustments to gas flow, pump speed, agitation, heating/cooling and the like. However, while the process control was highly automated between the in-situ sensor measurements, this is not the case for the Controller and the associated control hardware with process analyzers.

For many years the role of off-line process analyzers has been twofold:

1) Provide process measurements that were otherwise unavailable from in-situ sensors; and
2) Act as a reference to which the in-situ sensor measurements are compared.

This limited role could be directly attributed to their labor intensive manual operation and inability to interface effectively with the bioprocess controller. The latter raised serious questions about the justification of cost for an instrument that could not directly affect improved process quality or reliability but had a substantial annual cost of ownership in the form of both consumables and labor.

Today, everything we knew about the role of process analyzers has changed with the introduction of the Automated Reactor Sampling solution and its ability to create a bridge between the previously remote process analyzer and heavily networked Bioprocess Controller. As illustrated in Figure 2, the DeltaV Controller resides remote from the ARS and its associated process analytical instruments. In fact, the design of DeltaV allows it to be placed several hundred meters from the process suite. This ability to be highly remote is accomplished by the use of OPC technology and its communication via traditional Ethernet. In contrast, other SCADA or proprietary controller platforms often require the use of much older ASCII technology and thus can be limited to operating distances of several feet and raise concerns about the speed and integrity of the data being transmitted.

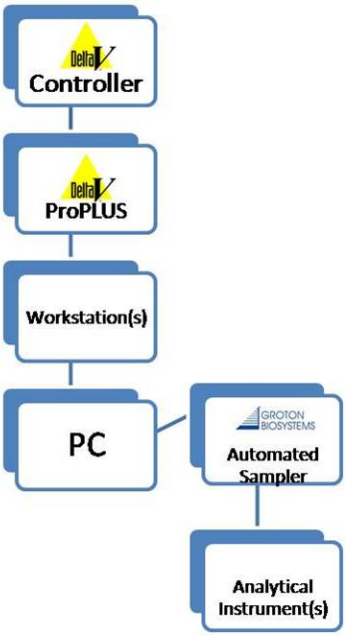

Figure 2

The physical interface between the ARS and the DeltaV, Figure 2, actually occurs via an Ethernet connection between the PC associated with the ARS and the DeltaV Controller. This Controller, referred to by Model (M5, MD, MD+), provides the DeltaV with its ability to effectively manage a large number of ARS solutions and their associated process analytical analyzers as key components in the process control strategy. However, the user interface between the ARS and the DeltaV is accomplished by means of the PC associated with the ARS and/or a DeltaV workstation as illustrated in Figure 2. It is important to note that in this integration the ARS solution resides on the DeltaV network and as such ***does not*** require a position on the corporate LAN.

Once integrated to the DeltaV Controller the ARS solution is capable of communicating process measurements from the process analyzers to the integral Data Historian of DeltaV or to a 3rd party data management solution such as PI. In either case, the shared data is transmitted in a 21 CFR Part 11 compliant format which can then be exported to a variety of report generating tools including DeltaV Reports, PI Process Book, etc.

The integration of the Automated Reactor Sampler and the DeltaV Controller has redefined the role of the process analyzer in three critical aspects:

1) Reduced Operating Costs

There are three (3) significant costs associated with the traditional practice of manual sampling. The first is the real cost of labor associated with manually sampling a process that often runs 24/7. Directly associated with the real labor cost is the cost associated with work force attrition attributable to the 24/7 nature of manual sampling. The third, and perhaps greatest real cost, is that of human error, which can cause inaccurate process data, which can create substantial challenges during technology transfer and/or result in lost process runs.

The integration of the Automated Reactor Sampling system to the DeltaV Controller allows reduced operating costs by providing the following:

a. Fully automated sampling of the process allowing persons previously associated with manual sampling to take on other roles or additional tasks.

b. The ability of the Controller to analyze process data from the ARS and generate a notification, such as e-mail or telephone call from the Controller, with specific alarm information which can then be viewed remotely.

c. Eliminate the possibility of human error as process data is electronically transmitted directly from the ARS to the Controller, and then into the integral Data Historian. The data is Time/Date stamped and any effort to change said data is recorded in the Event Log which records the identity of the person making the change, the nature of the change and its time and date. Of course, said changes are restricted to those authorized to have access for such changes.

2) Improved Process Quality

To date, in-situ sensor measurements available in the process have been limited to pH, dissolved oxygen, temperature, CO2, viability, conductivity and UV. While these measurements have provided some insight into the process they have not been successful in providing a complete process picture. The result has been the use of off-line process analyzers to provide critical process measurements such as glucose, glutamine, osmolality, proteins, etc. Regrettably, the off-line nature of these measurements has meant that critical process data has not been available from which to make changes in the process control strategy that would deliver improved quality.

The integration of the Automated Reactor Sampler to the DeltaV Controller allows improved process quality by providing the following;

a. The traditionally off-line process analyzers are brought online thus providing their process measurements in near real time for utilization by the Controller in the process control strategy; and

b. Availability of the measurements from the process analyzers to the Controller so that their role in the process can be automatically captured by the Data Historian

and the effects correlated to process behavior. The availability of this data improves technology transfer associated with greater process understanding.

3) Improved Process Reliability

It has been widely discussed that perhaps the single greatest cause of lost process runs can be attributed to in-situ sensors such as pH, dissolved oxygen, temperature, conductivity, etc. These sensors, whose very nature places them in direct contact with process conditions, are known to drift with prolonged exposure to the process and will eventually fail catastrophically. At best, there is inaccurate process data resulting in erroneous process control which must be remedied manually, and at worst a complete loss of the process run.

The integration of the ARS (Automated Reactor Sampler) to the DeltaV Controller allows improved process reliability by providing the following;

a. The adverse effects of in-situ sensor drift are eliminated as the process measurement values from the in situ sensors and process analyzers are evaluated by the Controller and in the event of a deviation greater than the allowable limit, automated sensor standardization occurs.

b. The ramifications of catastrophic sensor failure can be mitigated, or even eliminated, as the Controller is able to evaluate the process data from a controlling in-situ sensor as well as a process analyzer. In the event a deviation greater than that attributable to drift occurs it can switch to the redundant/monitoring sensor automatically. This decision to change controlling sensors is captured in the Data Historian and the associated process data can be referred to for justification purposes. Additionally, the introduction of digital protocols such as HART (Highway Addressable Remote Transducer) and Foundation fieldbus has enabled the Controller to continuously monitor the actual health of the in-situ sensors so as to predict their failure and thus prevent catastrophic process events.

To learn more about the role the Automated Reactor Sampling solution can play in reducing operating costs, improving process quality and improving process reliability specific to your application give us a call at 978-268-2910 or visit us on the web at www.grotonbiosystems.com.

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