

# **Writing Sequences of Operation using the Description of Controls Tool Suite**

## **Introduction**

The “art” of writing a quality Sequence of Operation is a learned skill. We in the HVAC business typically are not writers, at least not in the literary sense. Yet many of us are often called upon to describe our HVAC systems, in terms of how they are designed to operate and how they should be controlled. We may know in our heads how these systems should operate, as we are the ones designing them, but translating that into prose is not everyone’s forte. Compound that with the complexity of many of the systems that we design, and you end up with a real challenge. To describe the operation of HVAC systems with precision, accuracy, and completeness is typically not a very simple thing to accomplish. Suffice it to say that generating descriptive Sequences of Operation for HVAC systems is not everyone’s cup of tea. For those bold enough to undertake the task of writing a Sequence of Operation, this document and the suite of tools that accompanies it will hopefully make the process a little less painful and a little more structured.

## **Sequence of Operation vs. Description of Control: A Tale of Two Terms**

Although the above terms are often used interchangeably, there can be a distinction made between the two. For the purpose of this writing, we treat the terms separately, and define each term under this heading, starting with Description of Control.

When an engineer sets out to write about his mechanical systems design, as the first step he will account for all of the equipment that makes up the systems, and generate a basic framework from which he can develop a description. From there, he may choose to write simple “general narratives” of each piece of equipment and of how they operate within the systems. Without getting too detailed, the engineer accomplishes the task of accounting for all equipment, and of describing how each piece of equipment is to operate, individually and as part of a system. This is what is referred to (by this writing) as a Description of Control.

Descriptions of Control will tend to be fairly general, and are frequently created as the first step toward generating full-tilt Sequences of Operation. Descriptions of Control are what are typically generated for T/C submittal purposes, to be included in submittal packages (along with control diagrams, points lists, etc.). They can be fairly detailed, such as for “boilerplate” applications like packaged rooftop units and VAV boxes. However, they will generally be more streamlined, leaving out operational details such as exact setpoints, precise alarm limits, scheduling and time-of-day details, etc.

Sequences of Operation are generated as fully descriptive, detailed accounts of system operation. They will be developed during the design process, and finalized upon commissioning, when the operational details are initialized and validated. They will go into detail as much as they need to, in order to give the commissioning agent, service technician, end user, and anyone else involved with the systems a solid understanding of how the systems operate and how they are controlled. A Sequence of Operation is the final record of system operation, and is to be included on the control diagram “as built”, and/or as part of the operation and maintenance (O&M) manuals that are turned over to the customer.

It should be understood that the “suite of tools” that this document describes is more of a Description of Controls tool suite than a Sequence of Operation tool suite. Nevertheless, generating Descriptions of Control is a good first step toward writing full-blown Sequences of Operation, and, depending upon how detailed you need to be, a well written Description of Control can often pass for a Sequence of Operation.

## **Traditional Methods of Writing Control Descriptions**

Of course, the first time an engineer set out to describe the operation of an HVAC system that he designed, he basically started from scratch, as there was no existing verbiage to call upon as reference. As engineers plow through their careers, they tend to run across similar applications, and they call upon past projects to help them with their present design challenges. Writing control descriptions is no different, for we tend to call upon some past sequence that was written from an earlier design, and try to fit it to a current application. While this method is quite valid, especially when you compare it to “starting from scratch” every time you write a sequence, it is sometimes

difficult to remember just which job in your engineering past has the same or similar aspects of the job that you're currently working on. Creating a "tracking system" by categorizing projects and keeping the listing in a spreadsheet or database form can simplify your efforts and narrow your search for the past project that's similar to your current project. Yet maintaining such a database is a burden, and unless you're disciplined enough to keep the database up-to-date, the database eventually becomes of little use.

Copying and pasting portions of old sequences into new ones is a process that has been popularized via the (not-so) recent developments in computer technology. It's a simple task to "cut and paste" a chunk of text from an existing document into a new document. This method of generating control descriptions is valid, and has its merit. Yet care must be exercised so as to avoid redundancy, contradictory items, and inclusion of items that don't apply to the current system that is being described.

## **Description Types**

When a Description of Control needs to be created for a complete project consisting of many systems and equipment, the description of each individual system and each piece of equipment can be categorized as one of the following:

- Typical
- Custom
- From Scratch

A system or piece of equipment whose description can be categorized as "typical" is one whose operation is generally the same or similar in all applications, with little or no variance from application to application (with the exception of setpoints and other miscellaneous operational details). For Description of Control purposes, these types of systems and equipment can be described in a general manner, and these general descriptions can be used over and over again, for all applications consisting of such systems and equipment, with little modification to the descriptions, if any at all. Examples of such equipment falling under this category are packaged rooftop units (controlled by conventional thermostats), VAV and fan powered boxes, exhaust fans, and various unitary heating equipment.

"Custom" descriptions must be created for those systems and equipment whose attributes prevent them from being accurately described in a generic, reusable form. These types of systems and equipment are generally larger and more complex than those of which are categorized as "typical". Yet they are common enough to where "base" descriptions can be created, and hence customized to fit future applications. A boiler plant is an example of a system of which this would apply to. A description of a two-boiler, two-pump hot water system can be written for a particular project, and then modified or "customized" to fit a future project similar in design. Most of the more popular HVAC systems and equipment can fall under this category.

The purpose of the above paragraphs is to demonstrate that many types of systems and equipment will have **typical** descriptions that do not need to be written "from scratch". On the other hand, there will always be systems and equipment whose descriptions "must" be written **from scratch**. And somewhere in the middle of this, there are systems and equipment whose descriptions can be written from a "baseline" description, by **customizing** it for the specific application. The conclusion is that it is impossible to completely automate the process of generating a Description of Control. However, the process can be simplified, or "semi-automated", which is what this tool suite is all about.

## **Intention of this document**

This document is intended to enlighten the reader as to how Sequences of Operation are traditionally generated, and to instruct the reader on how to use the Description of Controls tool suite to generate control descriptions quickly and efficiently. The tool suite itself is created in an effort to standardize on the method of writing control descriptions, and make it easy to assemble a complete Description of Control for a project, by selecting from a library of pre-written modules for those types of systems and equipment that can be categorized as either Typical or Custom.

## **Description and Standard Procedure**

The tool suite consists of two major parts: the “Master”, and the “Library”. Correct usage of these components will help ensure a satisfactory end-product.

The Master is a Word document that is a framework used to create an overall Description of Control for a complete HVAC project. It contains some general headings, of which must be tailored for the given project. It also contains a Description of Control “outline” that consists of headings for all major equipment types. Finally, included under some of the equipment headings are “typical” descriptions.

The Library is a compilation of folders categorized by equipment type. In each folder are subfolders (as required), that further categorize the main folder. In the subfolders is where the individual descriptions are contained. These descriptions, again, are the Typical and the Custom. A binder containing printouts of all of the descriptions should be assembled, and used to facilitate the selection of the appropriate narratives for your particular systems and equipment.

### Develop the Framework

- ❑ Open the framework, titled MASTER, and save it as your project name.
- ❑ Complete the **Project Overview** section as necessary.
- ❑ Complete the **Control Systems Overview** section:
  - If it is a non-DDC project, use the NON-DDC OVERVIEW and delete everything else in front of it.
  - If it is a DDC project, then delete the NON-DDC OVERVIEW.
  - List out the major systems and equipment to be monitored and controlled by the DDC system, in the space provided.
  - Review the text that follows for anything that doesn’t pertain to the particular project. Revise as necessary.
  - List out the equipment that is *not* controlled by the DDC system, in the space provided.
- ❑ Go through the **Description of Control** section and delete all systems and equipment that do not apply.

### Compile the Typical and the Custom

- ❑ The Master contains many Typical; evaluate these for your needs, and use them as possible.
- ❑ Eliminate any Typical from the Master that don’t apply.
- ❑ Utilize the Library to obtain the Typical and the Custom that you require:
  - Use the binder of printouts to more easily find the descriptions that you need.
  - The printouts are “headered” with their file names.
  - Find each required file in the library, open it, select the text, and copy it.
  - Paste each description into the Master, in its appropriate place.
- ❑ Make any changes to the Typical as required.
- ❑ Modify the Custom, tailoring them to precisely fit the given applications.

### Create the “From Scratches”

- ❑ For those systems and equipment that do not have an applicable Typical or Custom description, you must create descriptions from scratch (sorry!).
- ❑ Understand the application at hand, and list out the important details that are to be included in the description.
- ❑ Generate a “rough draft”, in paragraph form, of the description.
- ❑ Review the description for accuracy and completeness.
- ❑ Check grammar and punctuation, and correct as necessary.
- ❑ Review the final draft, and if necessary, have a peer review it to determine if it is easily understood by someone other than the writer.
- ❑ Go through these steps for all systems and equipment that must have their descriptions generated from scratch.

### Proofread the Entire Document

- ❑ If possible, give yourself a day or two away from it, so that you can attain a more objective viewpoint.
- ❑ Read through the entire document, paying attention to grammar, accuracy, redundancy, etc.
- ❑ Make any changes that are required, and issue it with today’s date.
- ❑ Congratulations...You’re done! Give yourself a pat on the back, and move on to your next project.