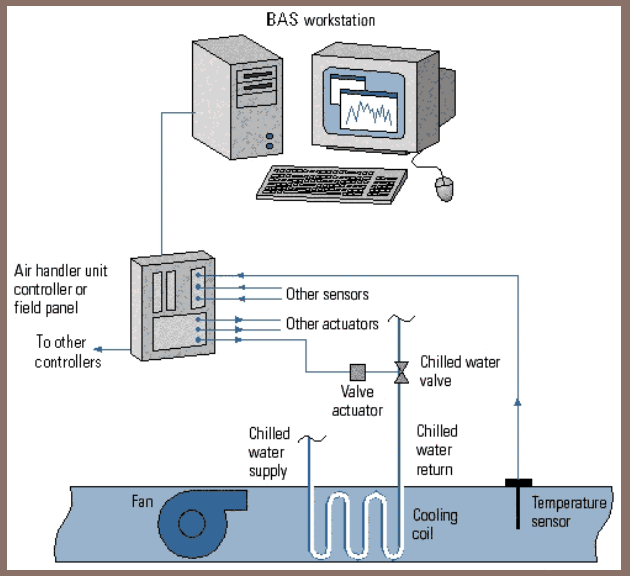


CONTROLS SPECIFICATION RECOMMENDATIONS

STEVE BROWN
DIRECTOR, CONTROLS DESIGN
BSA LIFESTRUCTURES

Don't Forget the Controls!

Agenda

- Overview
- Basic Facts
- Current Market Conditions/Realities
- Specification Structure
- Integration
- Resources

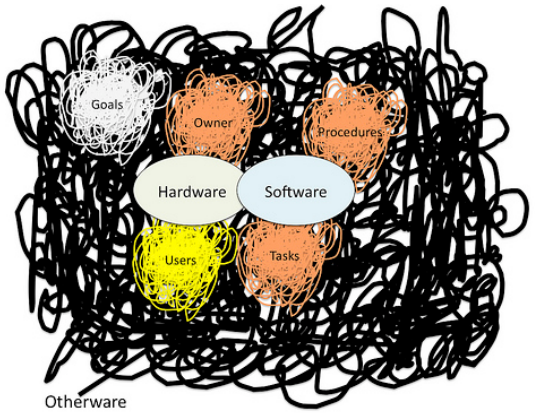
Overview

"An elephant is a mouse built to government specifications."

- Lazarus Long

Overview

- Why do we write specifications?
  - Convey Client needs/demands/expectations
  - Define specific project requirements
  - Establish “even playing field”
  - Protect Client and Specifier interests



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Basic Facts

- Every project with HVAC component has some level of controls involved
- Controls technology getting more complex
- Third-party Equipment and Systems becoming more "intelligent"
- Open Protocols – help or hinder?
- The Controls make the mechanical systems "go"
- The BAS system is the "window" to the mechanical systems

Market Conditions/Realities

- General market conditions – less new construction, more renovation
  - How does this affect control specification?
- Tighter budgets
  - What impact to specification process?
- Competition – smaller "pie"
- All of these impact specification development

$$\ddot{x} = \frac{1}{M-mt}\{mc_e + F_n(p - p_{atm_e}\,e^{-(k/H)(\sqrt{(x^2+y^2+z^2)}-R)})\}\cos\alpha(t) - g_0R^2\frac{x}{(x^2+y^2+z^2)^{3/2}} +$$

$$- \frac{c_w(\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)},\chi)}{M-mt}\rho_0\,e^{-(1/H)(\sqrt{(x^2+y^2+z^2)}-R)}F\dot{x}\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)} +$$

$$+ \frac{c_a(\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)},\chi)}{M-mt}\rho_0\,e^{-(1/H)(\sqrt{(x^2+y^2+z^2)}-R)}F \times$$

$$\times \frac{\dot{z}\{\dot{z}\cos\alpha(t) - \dot{x}\cos\gamma(t)\} - \dot{y}\{\dot{x}\cos\beta(t) - \dot{y}\cos\alpha(t)\}\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)}}{\sqrt{[\{\dot{y}\cos\gamma(t) - \dot{z}\cos\beta(t)\}^2 + \{\dot{z}\cos\alpha(t) - \dot{x}\cos\gamma(t)\}^2 + \{\dot{x}\cos\beta(t) - \dot{y}\cos\alpha(t)\}^2]}} + 2\dot{y}\omega + \omega^2 x$$

$$\ddot{y} = \frac{1}{M-mt}\{mc_e + F_n(p - p_{atm_e}\,e^{-(k/H)(\sqrt{(x^2+y^2+z^2)}-R)})\}\cos\beta(t) - g_0R^2\frac{y}{(x^2+y^2+z^2)^{3/2}} +$$

$$- \frac{c_w(\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)},\chi)}{M-mt}\rho_0\,e^{-(1/H)(\sqrt{(x^2+y^2+z^2)}-R)}F\dot{y}\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)} +$$

$$+ \frac{c_a(\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)},\chi)}{M-mt}\rho_0\,e^{-(1/H)(\sqrt{(x^2+y^2+z^2)}-R)}F \times$$

$$\times \frac{\dot{x}\{\dot{x}\cos\beta(t) - \dot{y}\cos\alpha(t)\} - \dot{z}\{\dot{y}\cos\gamma(t) - \dot{z}\cos\beta(t)\}\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)}}{\sqrt{[\{\dot{y}\cos\gamma(t) - \dot{z}\cos\beta(t)\}^2 + \{\dot{z}\cos\alpha(t) - \dot{x}\cos\gamma(t)\}^2 + \{\dot{x}\cos\beta(t) - \dot{y}\cos\alpha(t)\}^2]}} - 2\dot{x}\omega + \omega^2 y$$

$$\ddot{z} = \frac{1}{M-mt}\{mc_e + F_n(p - p_{atm_e}\,e^{-(k/H)(\sqrt{(x^2+y^2+z^2)}-R)})\}\cos\gamma(t) - g_0R^2\frac{z}{(x^2+y^2+z^2)^{3/2}} +$$

$$- \frac{c_w(\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)},\chi)}{M-mt}\rho_0\,e^{-(1/H)(\sqrt{(x^2+y^2+z^2)}-R)}F\dot{z}\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)} + \frac{c_a(\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)},\chi)}{M-mt}\rho_0 \times$$

$$\times\ e^{-(1/H)(\sqrt{(x^2+y^2+z^2)}-R)}F\,\frac{\dot{y}\{\dot{y}\cos\gamma(t) - \dot{z}\cos\beta(t)\} - \dot{x}\{\dot{z}\cos\alpha(t) - \dot{x}\cos\gamma(t)\}\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)}}{\sqrt{[\{\dot{y}\cos\gamma(t) - \dot{z}\cos\beta(t)\}^2 + \{\dot{z}\cos\alpha(t) - \dot{x}\cos\gamma(t)\}^2 + \{\dot{x}\cos\beta(t) - \dot{y}\cos\alpha(t)\}^2]}}$$

in which: $\chi = \arccos\dfrac{\dot{x}\cos\alpha(t) + \dot{y}\cos\beta(t) + \dot{z}\cos\gamma(t)}{\sqrt{(\dot{x}^2+\dot{y}^2+\dot{z}^2)}}$

Specification Structure

- Part 1 – General
- Part 2 – Products
- Part 3 – Execution

Specification Structure

- **Part 1 – General**
- Part 2 – Products
- Part 3 – Execution

Specification Structure

- **Part 1 – General**
  - General Scope Description and Project Requirements
  - **Related Specification sections**
    - Field-installed components
    - Integration requirements
    - Suggest related sections “match” control spec
  - Codes and Standards
  - **Approved/Qualified Manufacturers/Contractors**
  - Submittal/Documentation Requirements

Specification Structure

- Part 1 – General
- **Part 2 – Products**
- Part 3 – Execution

Specification Structure

- **Part 2 – Products**
  - Edit to include equipment that apply to specific project
  - DDC Hardware
    - Most have similar attributes – web-based, open protocols, graphics, trending, reporting, etc.
    - All have nuances that make their products slightly different – making it a challenge for specifier
  - Standard End Devices
    - Temperature Sensors, Humidity Sensors, CO2 Sensors, Low limits, Dampers, Damper Actuators, Control Valves
  - Specialty End Devices
    - VFDs, Air Flow Measuring devices, Flow Meters, Refrigerant Sensors, CO Sensors, Room Pressure Monitors/Controllers

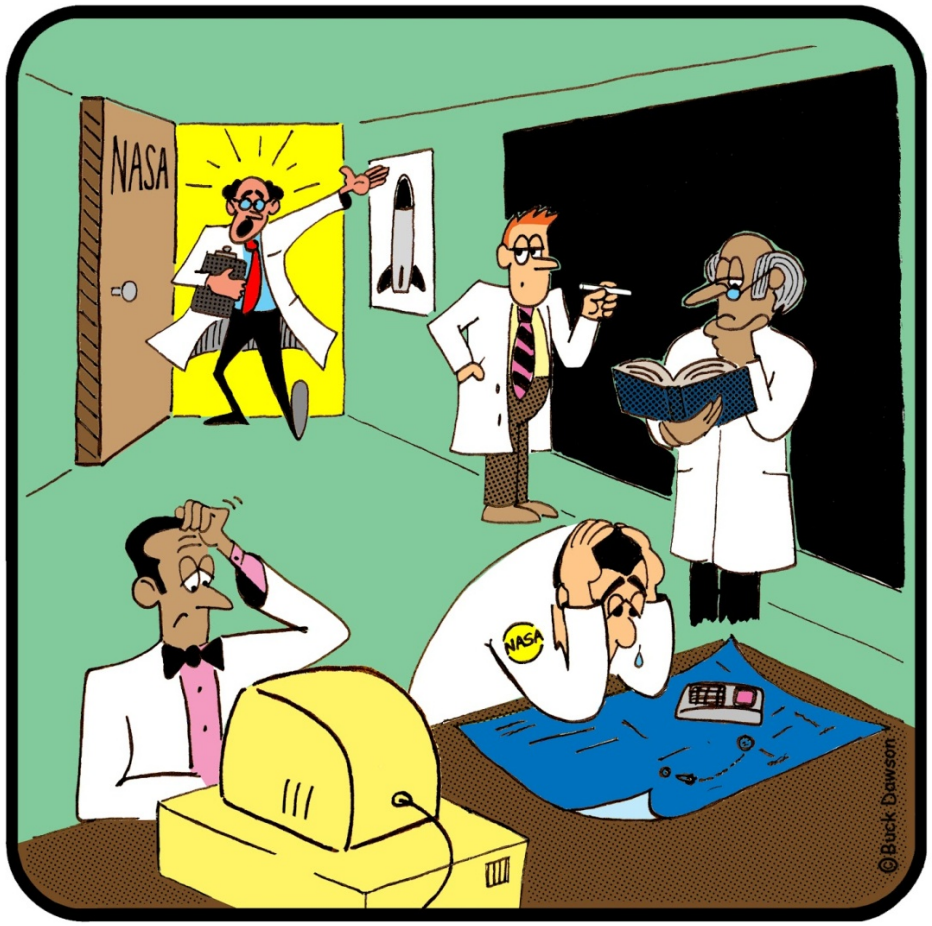
Specification Structure

- Part 1 – General
- Part 2 – Products
- **Part 3 – Execution**

Specification Structure

- **Part 3 – Execution**
  - Installation Requirements
    - Be wary of code requirements – especially electrical
    - Specific site requirements, precedence
    - May need to adjust products to meet installation requirements – exterior locations, explosion-proof, wet locations, etc.
  - Checkout/Commissioning Requirements
  - Training/Demonstration Requirements
  - Warranty/Service/Maintenance Requirements

Integration



"So what's the problem here fellas?
C'mon now -- it's only rocket science!"

Integration

- What is Integration?
  - Discrete point monitoring? Data passing? Interoperability?
  - Need to specify – "integrate all points available" and "BACnet/LON-compliant/conformant" is not sufficient.
- Why?
  - Take advantage of data and "intelligence" built into equipment and systems
  - Number and types growing and expanding
- How?
  - Open Protocols = Tools, not solutions
- Define in controls specification AND related specification section

Integration

- Section 22 11 13 – Facility Fuel Oil System.
- Section 22 11 23 – Packaged Booster Pumps.
- Section 22 11 24 – Variable Speed Packaged Booster Pumps.
- Section 22 13 29 – Sewage Pumps.
- Section 22 14 29 – Sump Pumps.
- Section 22 15 19 – General Service Compressed Air Equipment.
- Section 22 31 16 – Water Softeners.
- Section 22 34 00 – Fuel Fired Domestic Water Heaters.
- Section 22 67 19 – RO/Deionized Water Equipment.
- Section 23 25 00 – HVAC Water Treatment.
- Section 23 52 16 – Condensing Boilers.
- Section 23 52 33 – Water Tube Boilers.
- Section 23 52 39 – Fire Tube Boilers.
- Section 23 53 16 – Deaerators, Surge Tanks and Blowdown Separators.
- Section 23 64 16 – Centrifugal Water Chillers.
- Section 23 64 26 – Rotary Screw Air-Cooled Water Chillers.

Integration

- Section 23 65 00 – Cooling Towers.
- Section 23 72 00 – Air-To-Air Energy Recovery Equipment.
- Section 23 81 23 – Computer Room Air Conditioners.
- Section 23 84 13 – Humidifiers.
- Section 26 09 13 – Electrical Power Monitoring and Control.
- Section 26 09 43 – Network Lighting Controls.
- Section 26 11 16 – Secondary Unit Substations.
- Section 26 12 00 – Medium Voltage Transformers.
- Section 26 23 13 – Paralleling Low Voltage Switchgear.
- Section 26 24 13 – Switchboards.
- Section 26 24 19 – Motor Control Centers.
- Section 26 27 13 – Electricity Metering.
- Section 26 29 23 – Variable Frequency Controllers.
- Section 26 32 13 – Engine Generators.
- Section 26 33 53 – Static Uninterruptible Power Supply.
- Section 26 36 00 – Transfer Switches.
- Section 26 56 00 – Exterior Lighting.

Resources

- Construction Specifications Institute - CSI
- On-line specification resources
  - www.CtrlSpecBuilder.com
  - www.trane.com/ENGINEER/
- Control Contractors
- Equipment Vendors – Valves, Flow Meters, Specialty Sensors, Pressure Monitors, etc.

- Ultimately the spec is YOURS, make it fit YOUR needs and requirements!

Questions?


THANK
YOU