

CENTRAL ENERGY PLANT COMMISSIONING: FACTORY ACCEPTANCE TESTING OF CONTROLS

Presented by:

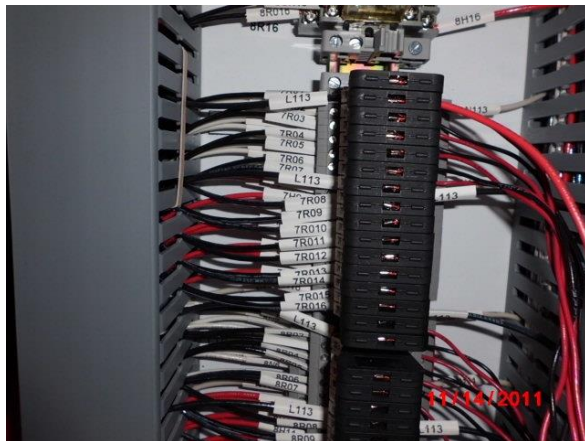
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LEARNING OBJECTIVES:

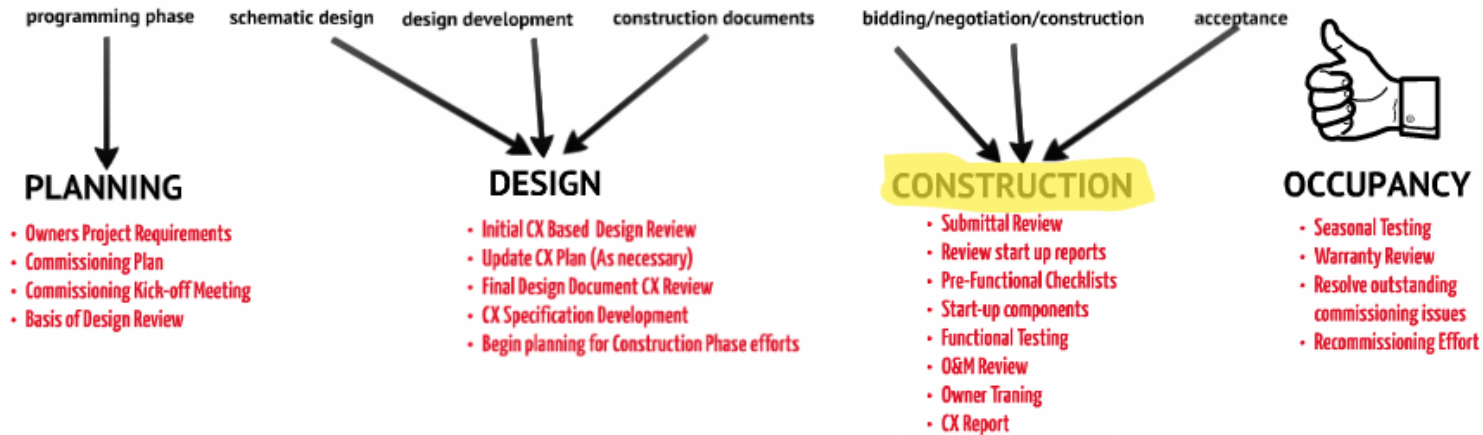
- Overview of **commissioning process**
- High level industrial **controls** understanding
- **Understanding** of a controls factory acceptance test
- How to incorporate into **project schedule**
- Discussion of **benefits**



COMMISSIONING PROCESS OVERVIEW



COMMISSIONING PROCESS: OVERVIEW



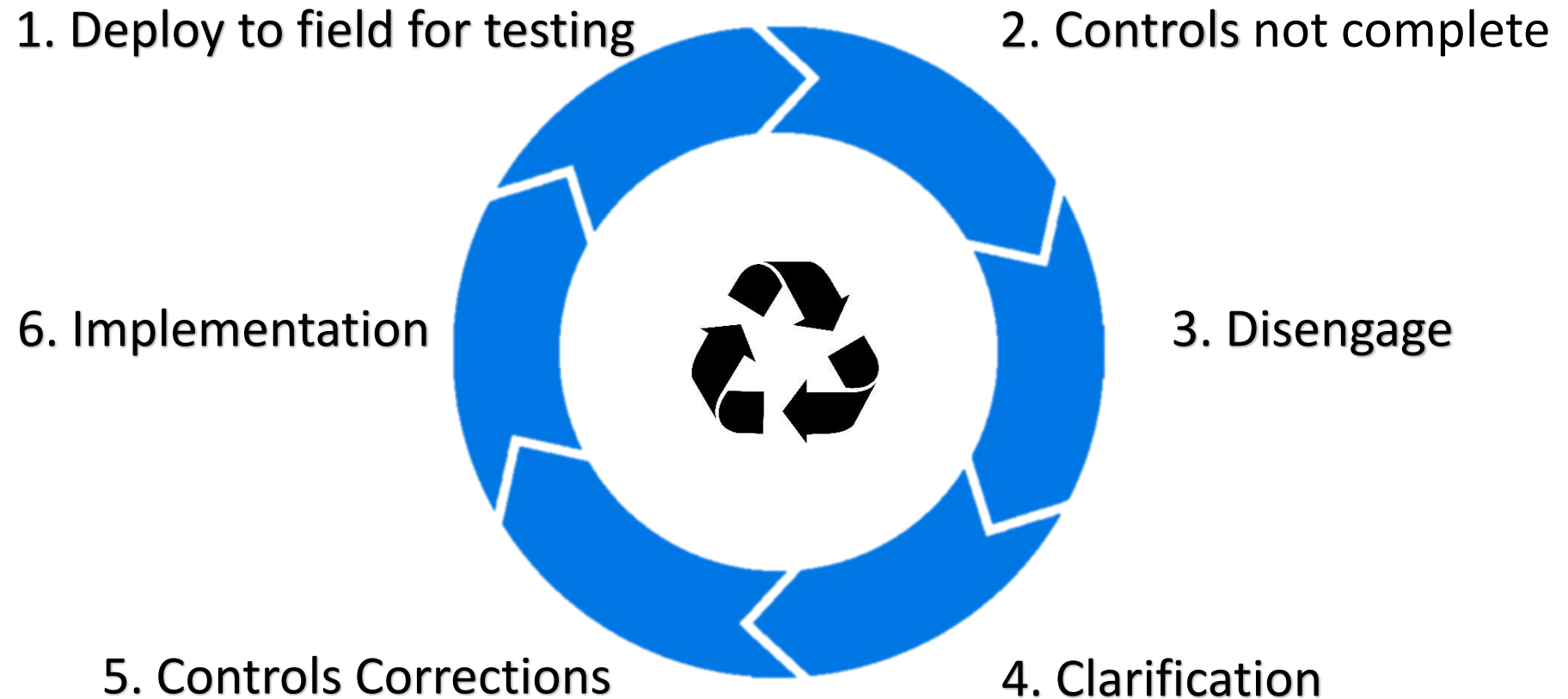
- Process that establishes the plant performance as designed
- Means to verify AND DOCUMENT a system's performance
- Identify construction anomalies and provide SOLUTIONS
- Creates a benchmark used for future retuning

COMMISSIONING PROCESS: WHY COMMISSION?

- More complex MEP systems
- Identifies systems that are unfinished
- Completes building turnover
- Tests sequencing for efficiency
- Provides long term performance insight



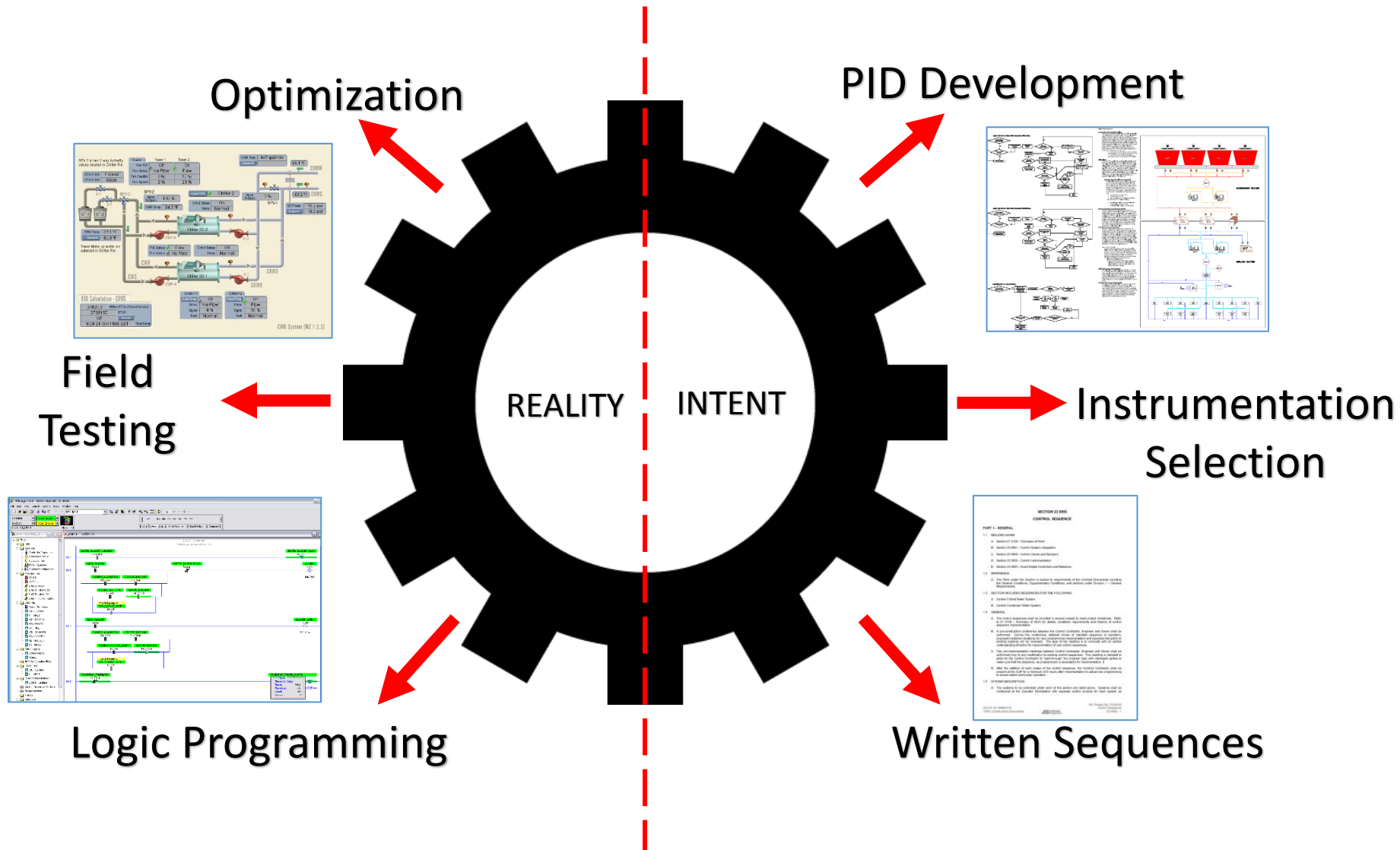
COMMISSIONING PROCESS: **CONTROLS FIELD TESTING CYCLE**



CONTROLS OVERVIEW

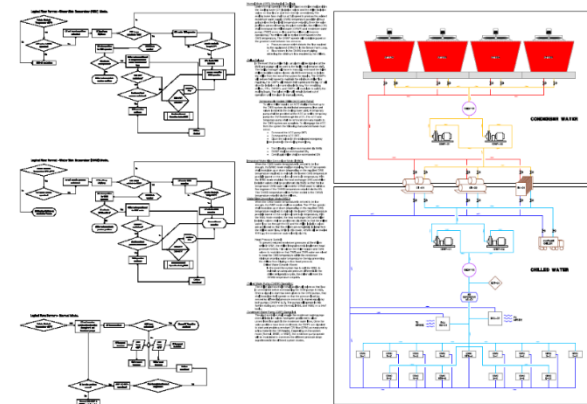
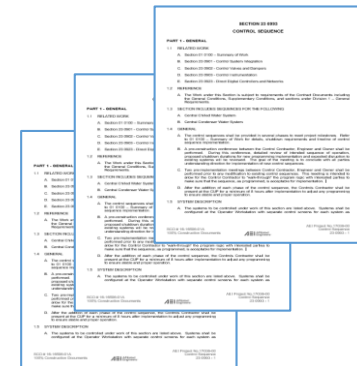
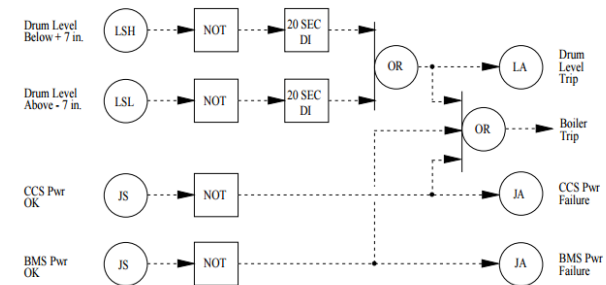


CONTROLS OVERVIEW: EVOLUTION



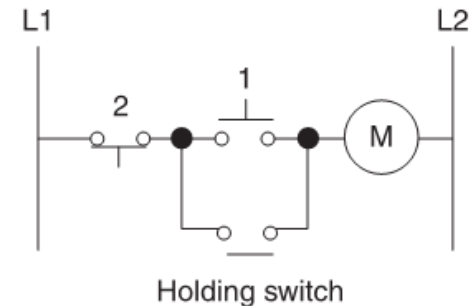
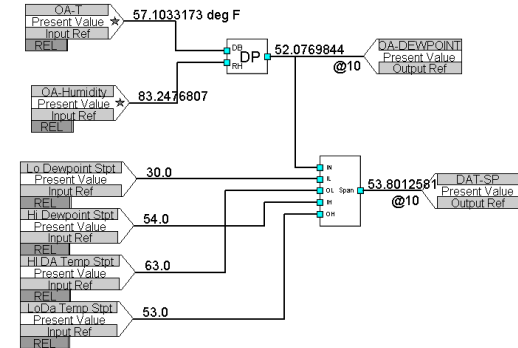
CONTROLS OVERVIEW: TYPES OF DESIGN

- SAMA (Scientific Apparatus Makers Association)
 - **Pro:** Best design layout for programming
 - **Con:** Difficult to understand
- Written control sequences:
 - **Pro:** Easy to understand
 - **Con:** Interpretation and logic difficult to program
- Combination of both:
 - **Pro:** Easy to program and understand
 - **Con:** Costly to incorporate and takes high level design



CONTROLS OVERVIEW: DIFFERENT TYPES OF LOGIC

- Function Block Diagrams
 - A **graphical** depiction of process flow using simple and complex interconnecting blocks. Mainly used in DDC, DCS and BAS systems.
- Ladder logic
 - A **graphical** depiction of a process with rungs of logic, similar to the relay ladder logic schemes. Mainly used in PLC's.
- Structured Text
 - A high-level, **text based** language such as BASIC, C, or PASCAL.



```
37
38 #SPDIMP2:=(DINT_TO_REAL(#Distance)/DINT_TO_REAL(#RampDIST
39 If #SPDIMP2>#MaxSPDIMP Then #SPDIMP2:=#MaxSPDIMP; End_If;
40 If #SPDIMP2<#MinSPDIMP Then #SPDIMP2:=#MinSPDIMP; End_If;
41 #PR:=#ActualPOS>=(#TargetPOS-(#PosWIN/2)) AND #ActualPOS<
42 If #Speed>#SPDIMP Then #Speed:=#SPDIMP; End_If;
43 Else //JOG mod *****
44 If #JOGP Then #DIR:=TRUE; End_If;
```

CONTROLS OVERVIEW: CONSTRUCTION CHALLENGES

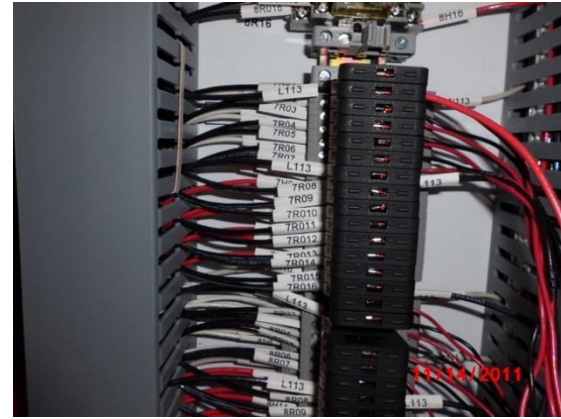
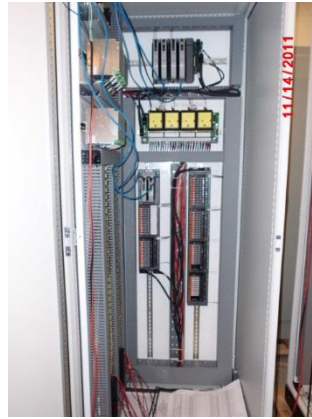
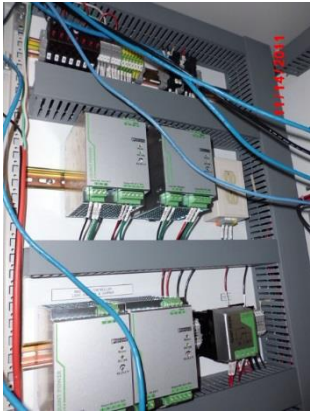
- Systems not completed at time of performance testing
- Controls sequences not clear or interpreted correctly
- Design changes to make field corrections
- Controls schedule compressed during construction
- Written sequence ambiguity
- Delayed owner move-in
- Repeated functional testing effort in the field
- Pressure to accept systems before operational issues are resolved



CONTROLS FACTORY ACCEPTANCE TESTING

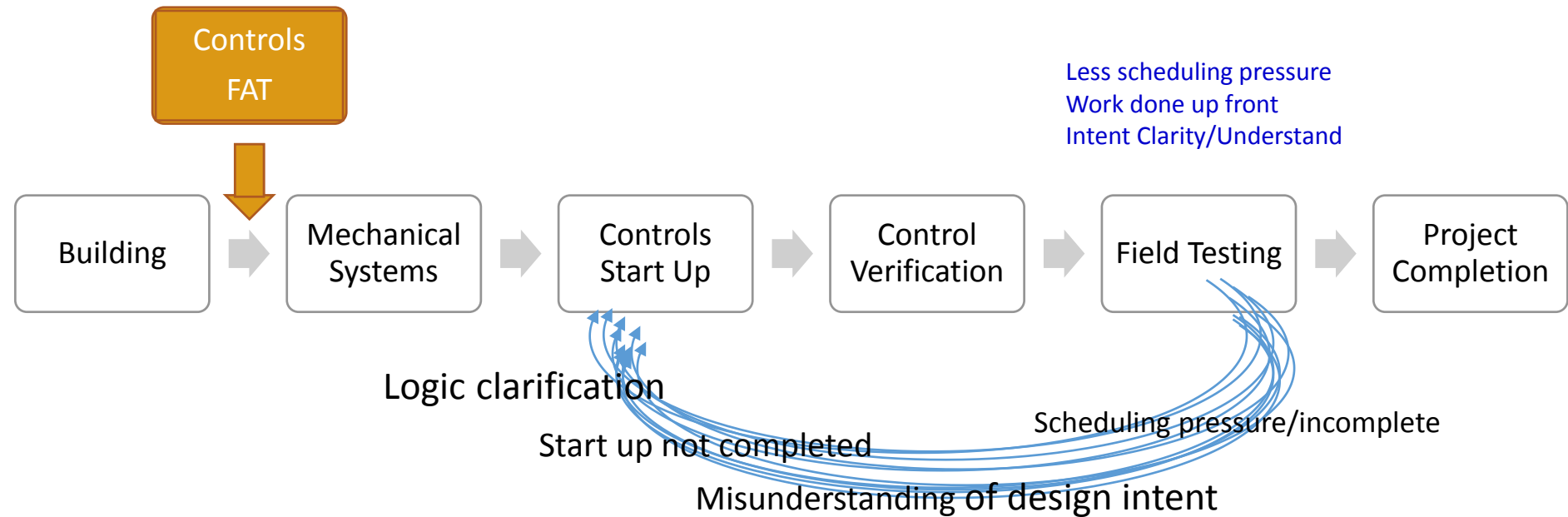


CONTROLS FACTORY ACCEPTANCE TEST (FAT):



- Understanding of defined performance
- Meets plant's unique requirements
- Streamlines field testing and integration
- Verifies reliability and availability
- Clear vision and path forward for CX: Functional Testing
- Execution of logic testing in a CONTROLLED ENVIRONMENT

CONTROLS FAT: SCHEDULE IMPACT

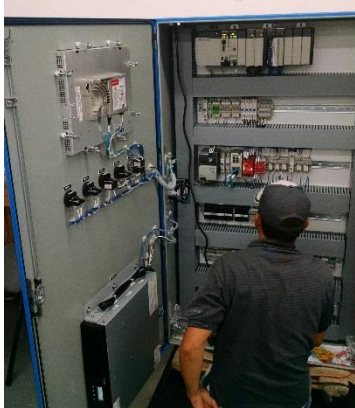


CONTROLS FAT: **PROJECT INTEGRATION**

- Provide detailed **COMMISSIONING SPECIFICATIONS**
 - Controls FAT should be lead by your commissioning engineer
- Create and develop testing scripts early in **the PROCESS**
- Develop relationship with controls contractor that will work with you
- **Execute FAT early in** construction
- Stakeholder involvement crucial for success:
 - **Commissioning Engineer**
 - **Controls Design Engineer**
 - **Facility Operator**
- **CHANGE THE PROCESS PARADIGM**



CONTROLS FAT: COMMON ISSUES REVEALED



- **Redundancy** requirements of the plant
- **Alarm** configuration and levels undefined
- Logic and **goals** for the facility not aligned
- Sequence of operation **incomplete**
- **Continuity** between graphics and existing campus graphics
- Set point and **alarm** (trigger) points do not align with design
- Default “**canned**” controls are still in place and not modified

CONTROLS FAT: **BENEFITS**



- Control logic clarification occurs early in project
- **Stakeholders** present for clarification
- System readiness
- No surprises after installation or during functional testing
- **Reduce schedule pressure**

QUESTIONS?

