
LEADING THE WAY
CampusEnergy2022
Feb. 15-18 | Westin Boston Seaport District Hotel | Boston, Mass.
INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION

Redundant and Resilient Control System Design for District Energy Facilities

Grant Selking, Thermo Systems

Haig Monokian, P.E., Thermo Systems

Grant Kircher, Thermo Systems

LEADING THE WAY
CampusEnergy2022
Feb.15-18 Westin Boston Seaport District Hotel Boston, MA

THERMO SYSTEMS
INDUSTRIAL AUTOMATION & INFORMATION

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Topics of Discussion

- What is a redundant design? How does it differ from a resilient design?
- Different types of redundancy and resiliency
- Design, operation, and strategies for successful implementation
- Cost impacts and considerations

Definitions

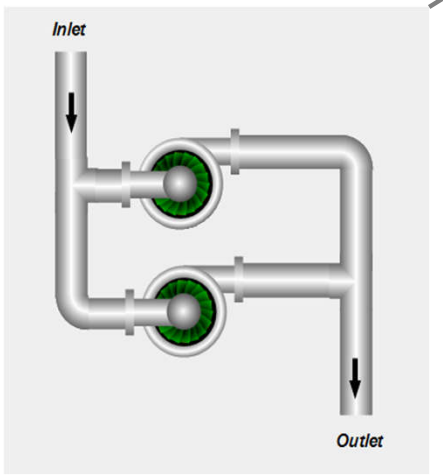
Redundant Design:

Designed with failure of a component in mind, usually with one or more other components to mitigate the failure.

Resilient Design:

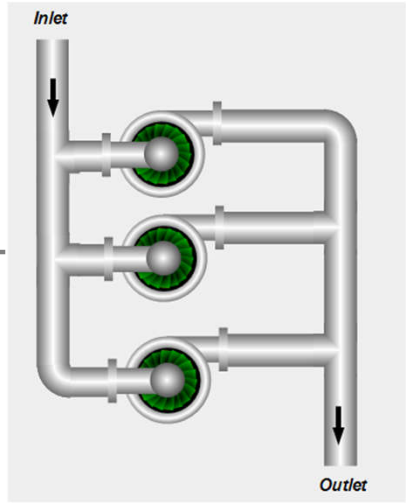
Allows the system to recover from a fault, failure or other system disturbance.

Types of Redundancy



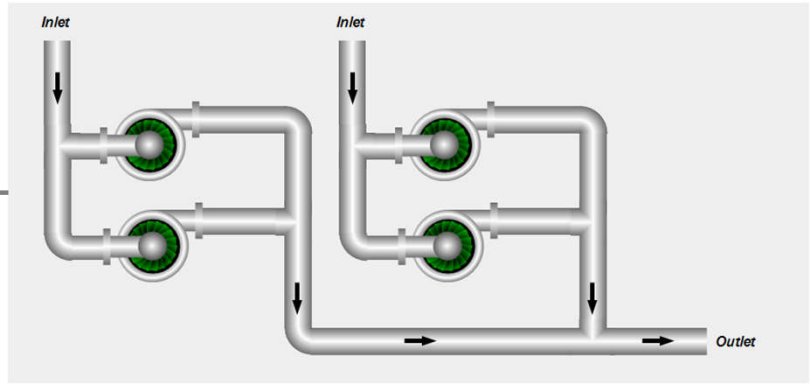
N – Operational Design (maximum). No Fault tolerance; single point of failure

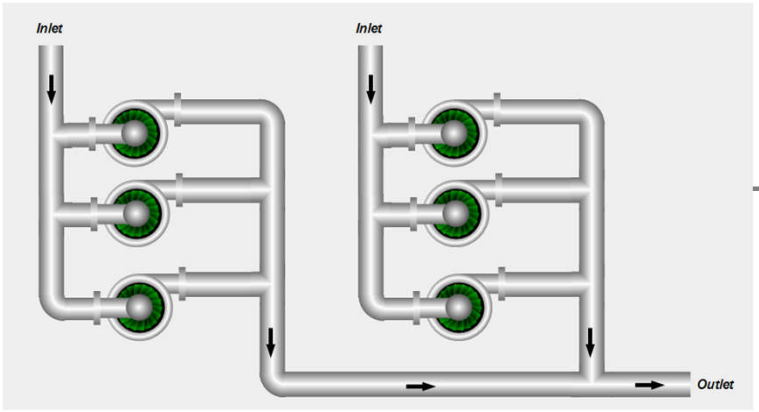
N+1 - Normal operating conditions with single point of failure tolerance



Types of Redundancy

2N – Fully redundant with no single level fault tolerance





2N+1 - Fully redundant with single level fault tolerance

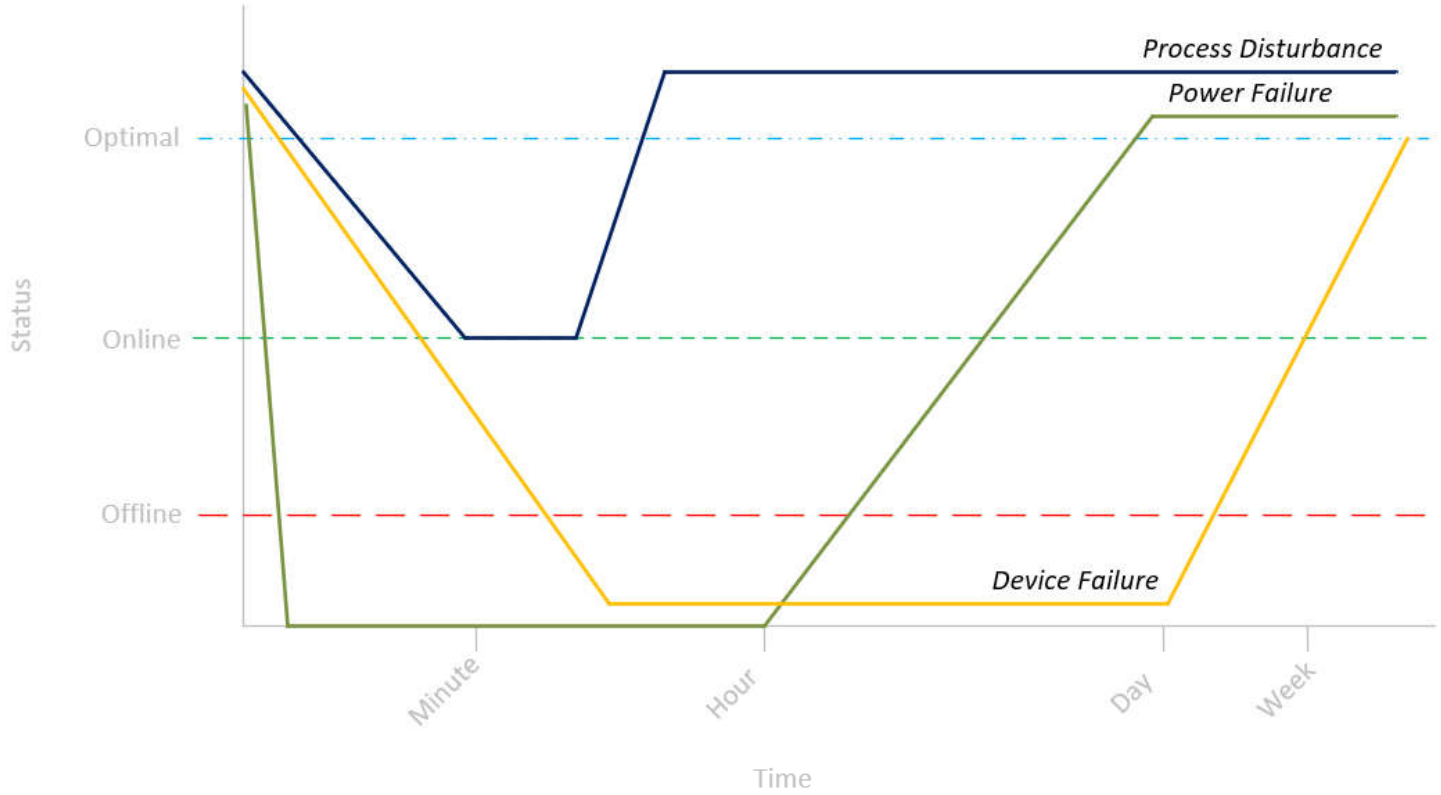
Resiliency Scenarios

Process Disturbance – Ability to react and stabilize the system operation

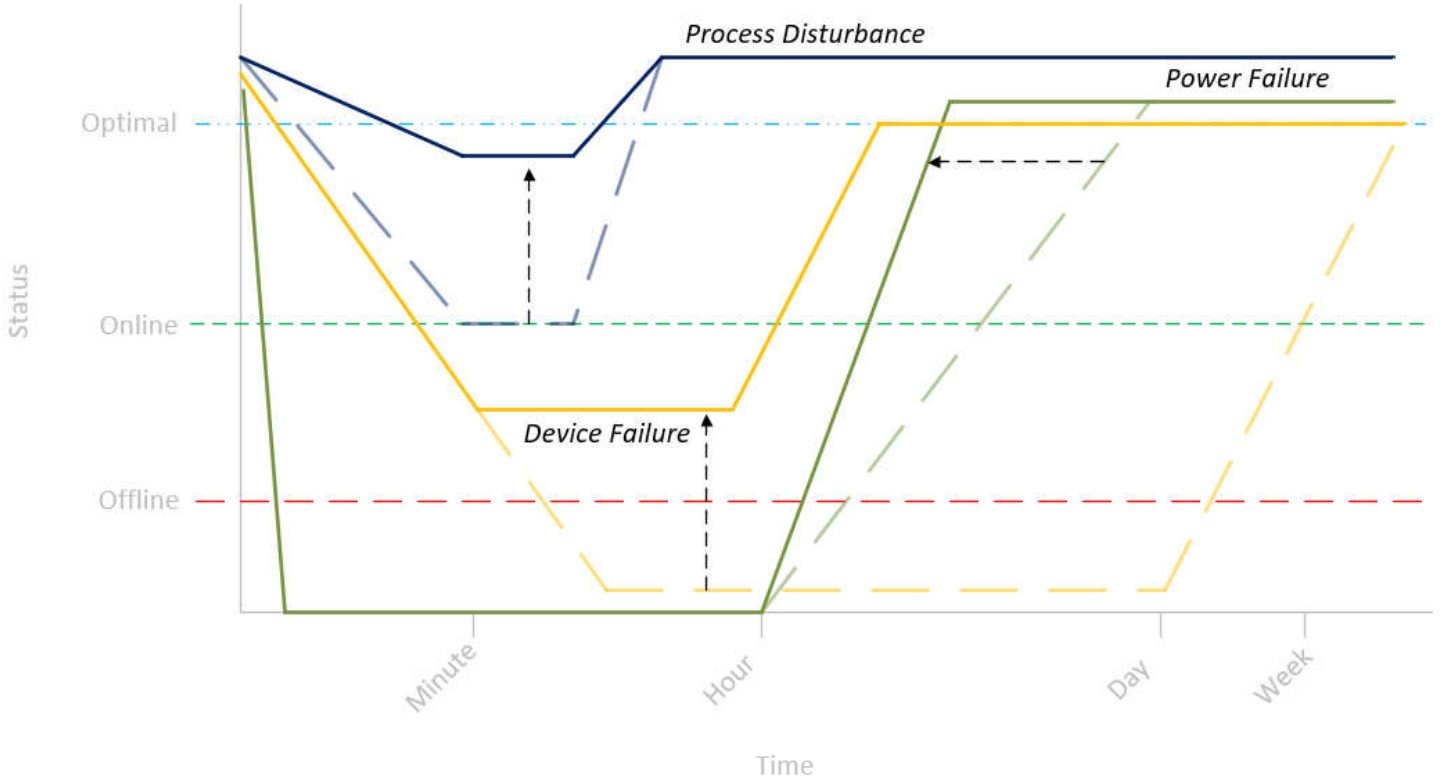
Power Failure – Can the system effectively recover after a power outage?

Device Failure – How quickly can the system recover from a device failure?

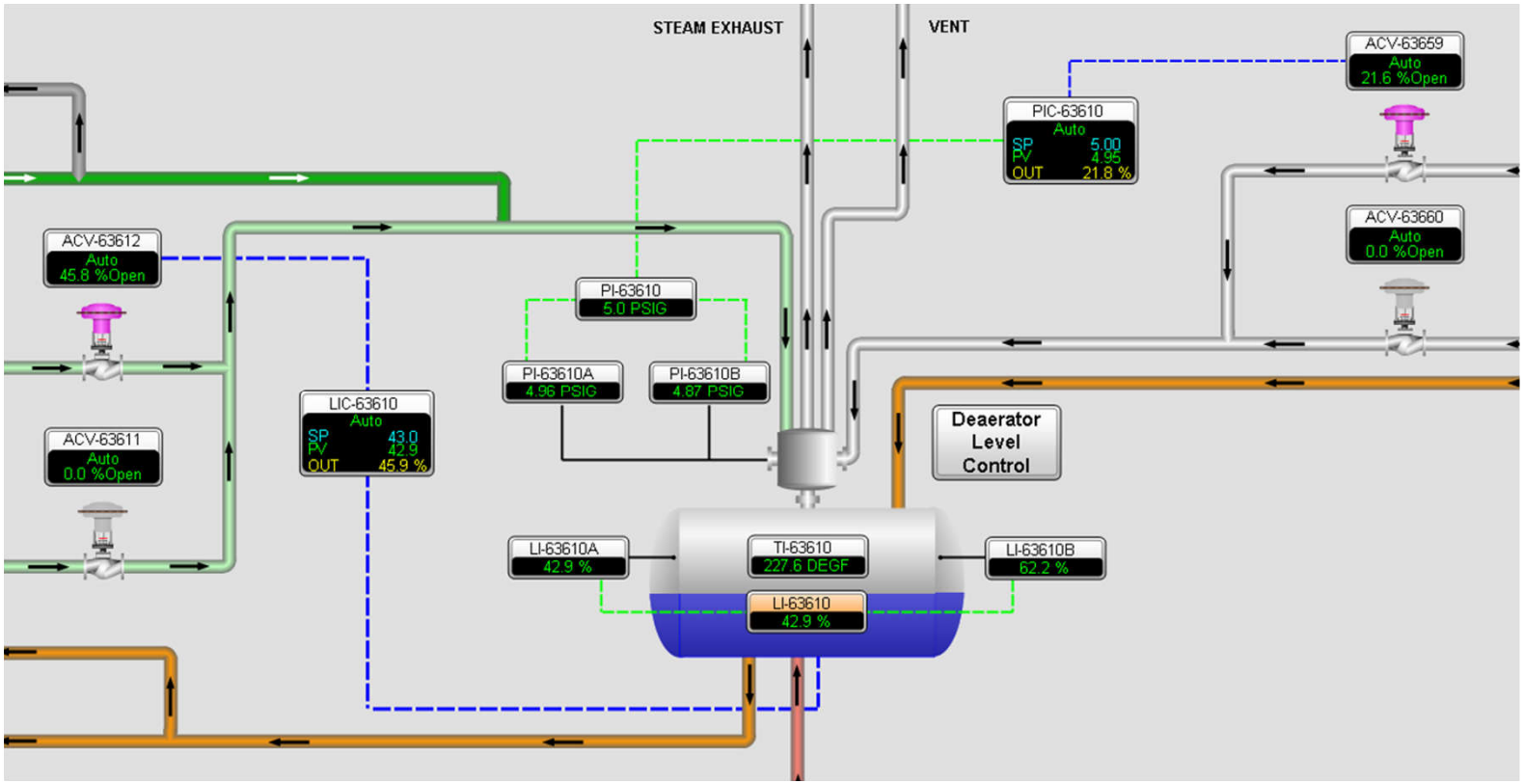
Resiliency Scenarios



Resiliency Scenarios

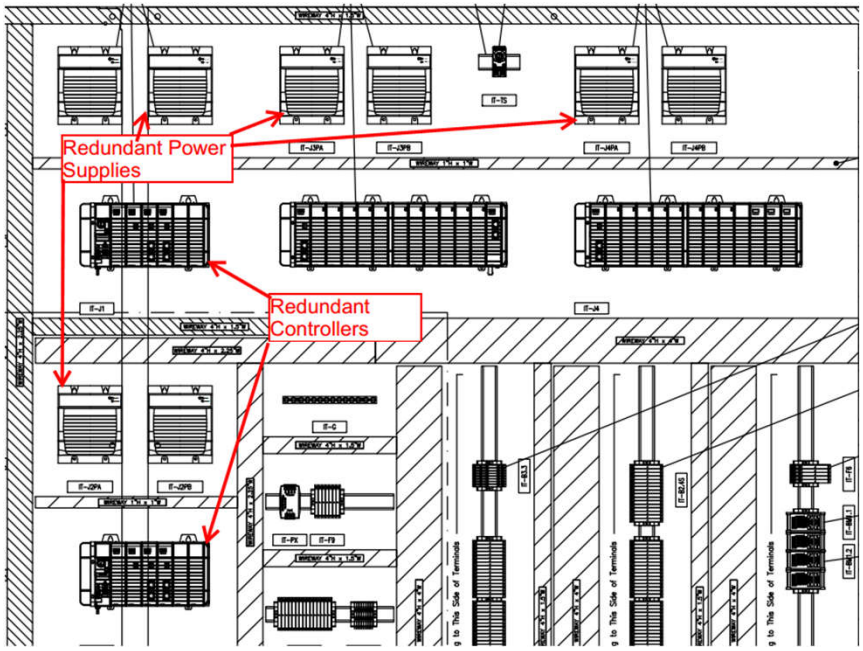


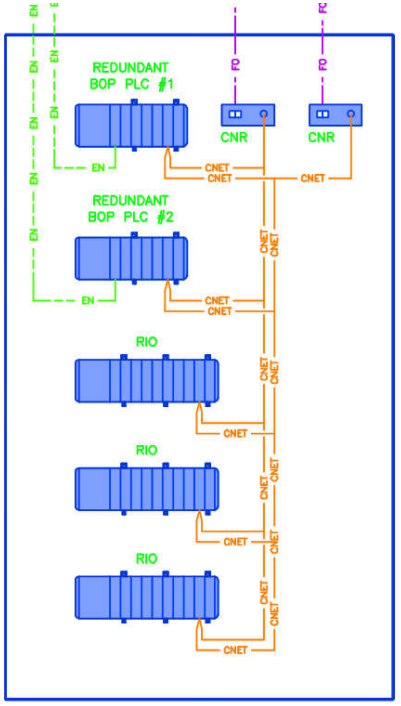
System Redundancy Example



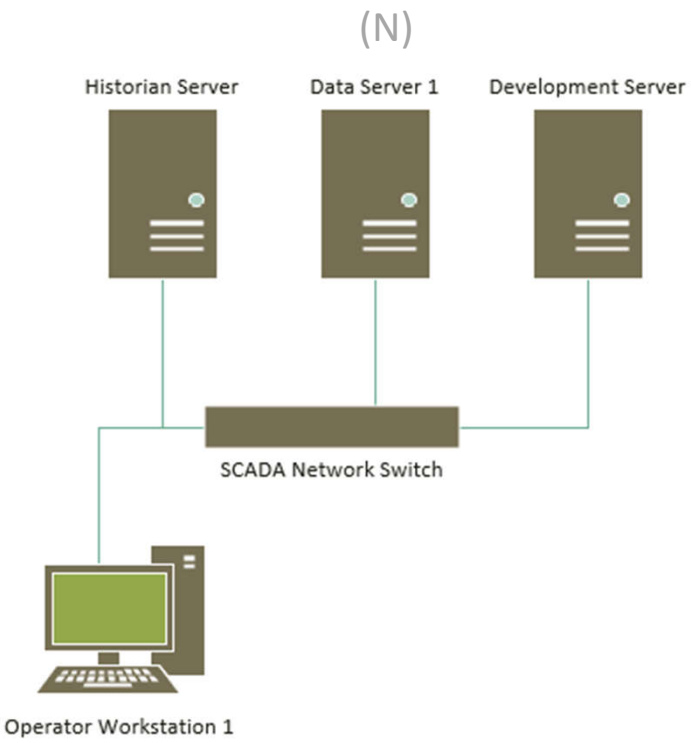
Control Systems Architecture

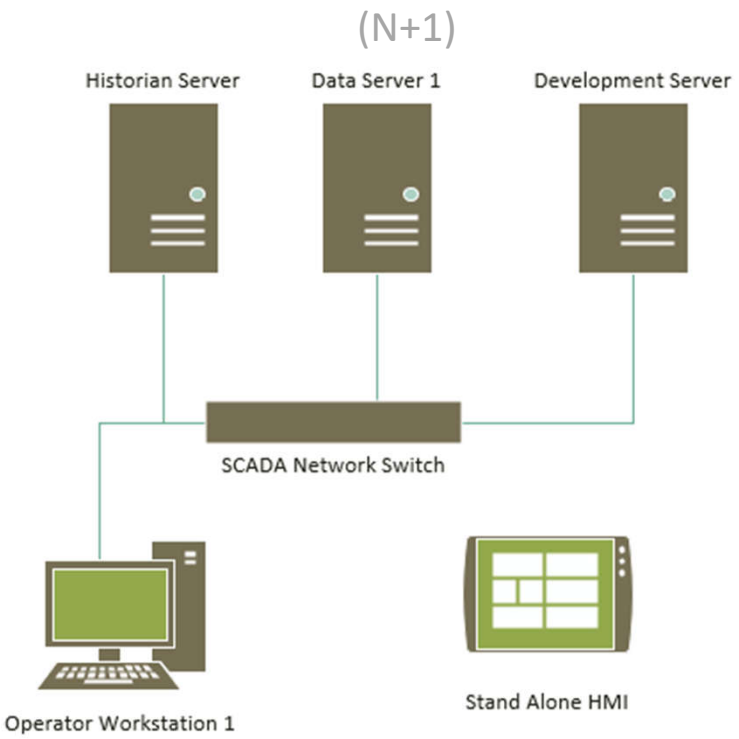
Physical setup (networking (IO Level / Controller Network), multiple cabinets, Controller Architecture)





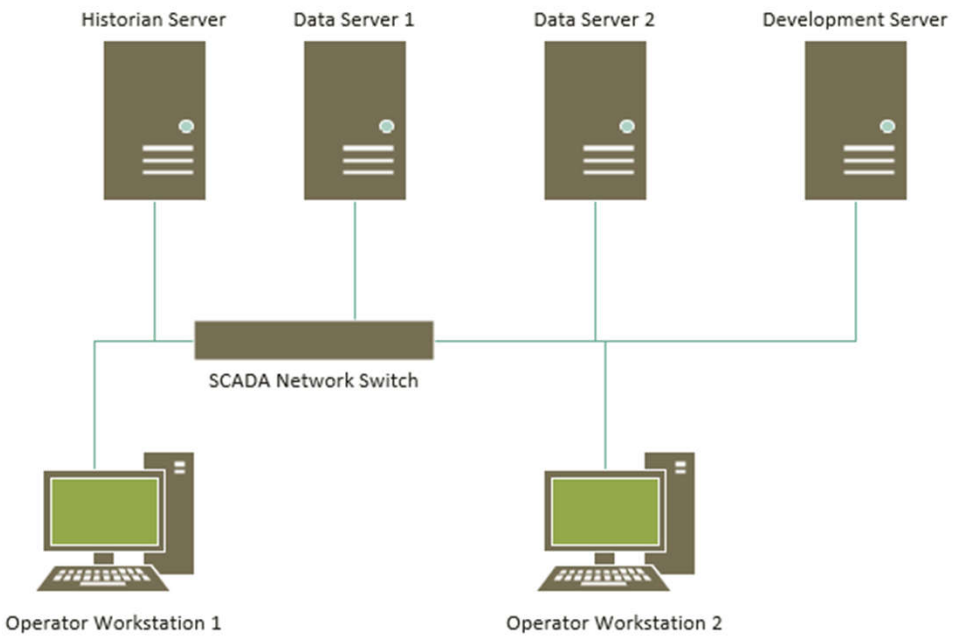
Supervisory HMI Architecture



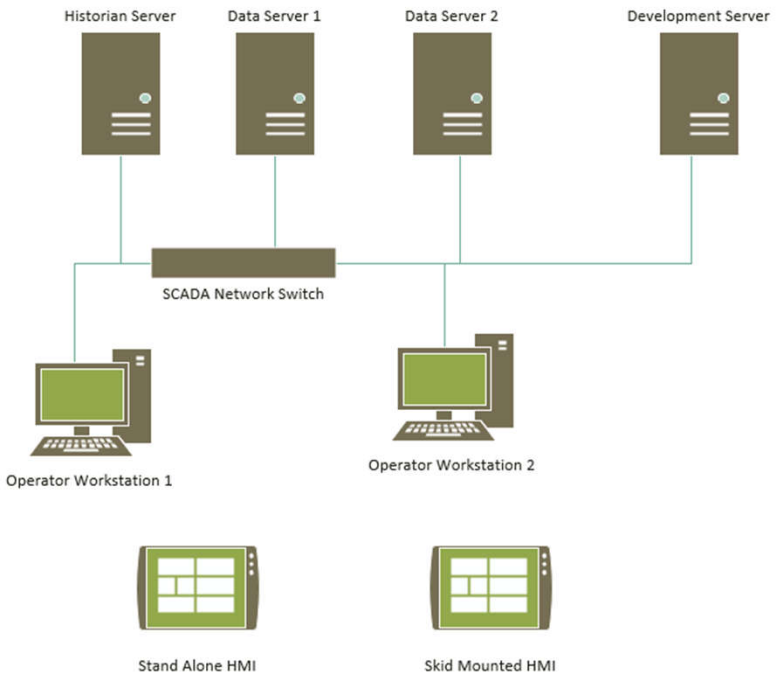


Supervisory HMI Architecture

(2N)

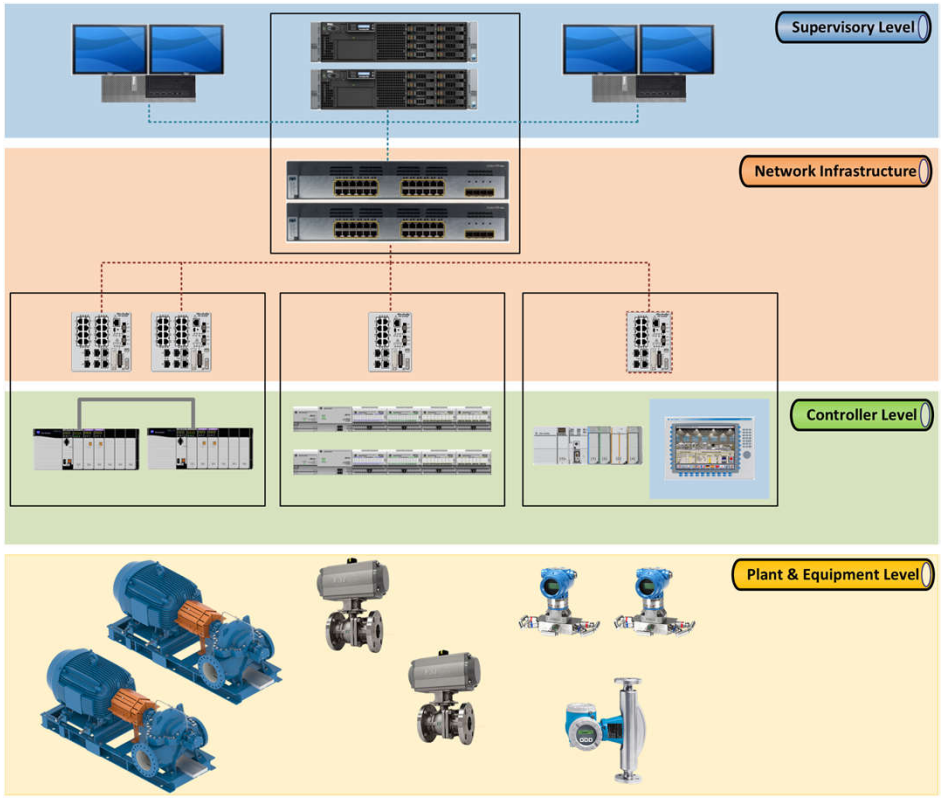


(2N+1)



Cost Impacts and Considerations

- Supervisory Level
- Network Infrastructure
- Controller Level
- Plant and Equipment Level



Cost Impacts and Considerations

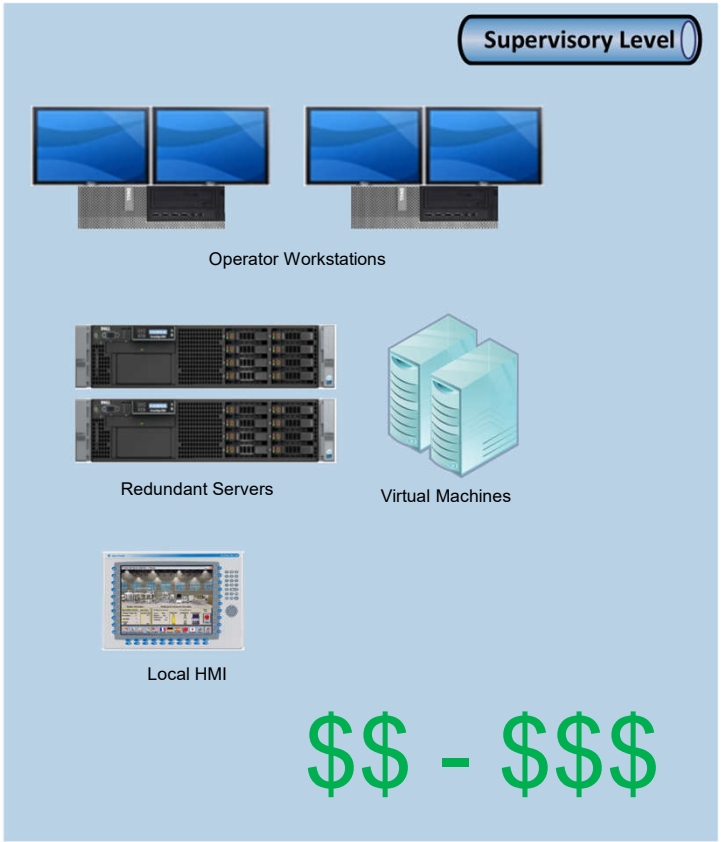
- Field devices, equipment, sub-systems
- Up-front costs
- Life cycle costs – long term planning
- Straight forward and Tangible

Cost Impacts and Considerations

- Controller redundancy for Balance of Plant (BOP) vs. equipment/sub-system
- Approximately 1.5x more controller hardware cost
- Other redundant and resilient strategies at the controller level

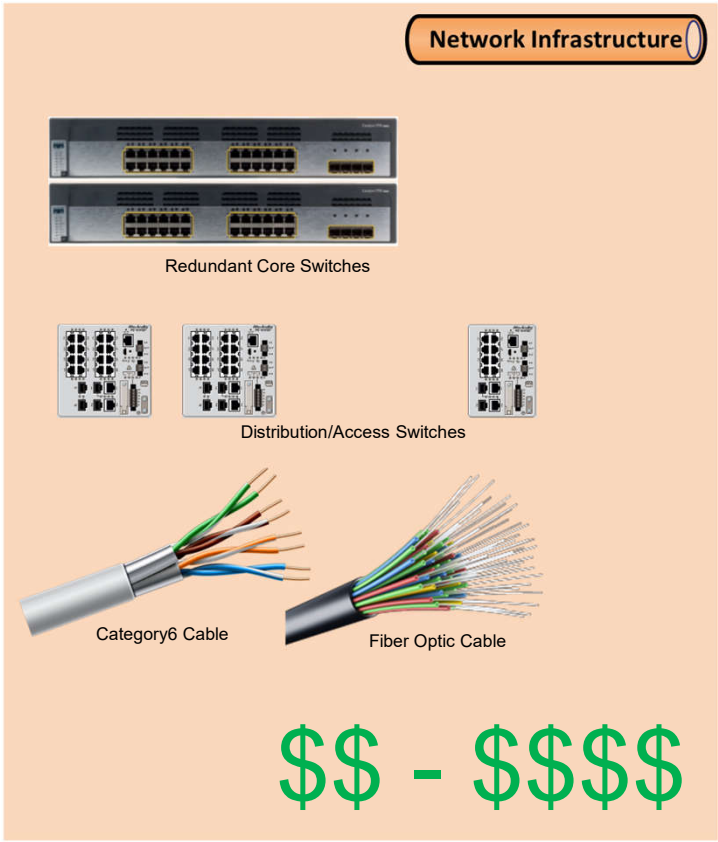
Cost Impacts and Considerations

- Redundant hardware and software licenses
- Approximately 2x more supervisory hardware & software cost
- Other redundant and resilient strategies at the supervisory level



Cost Impacts and Considerations

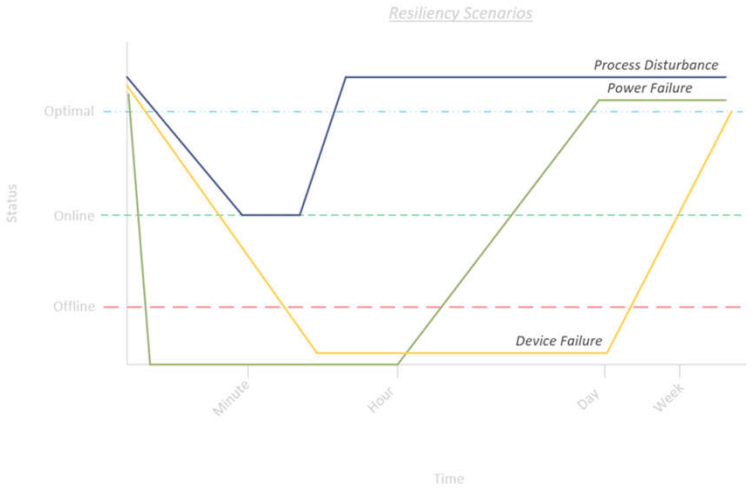
- Redundant hardware
- Approximately 2x more network hardware cost
- Physical infrastructure
- Other redundant and resilient strategies for network infrastructure



Exercise 1 - Thoughts

<u>Think about a resiliency scenario within your system or design</u>

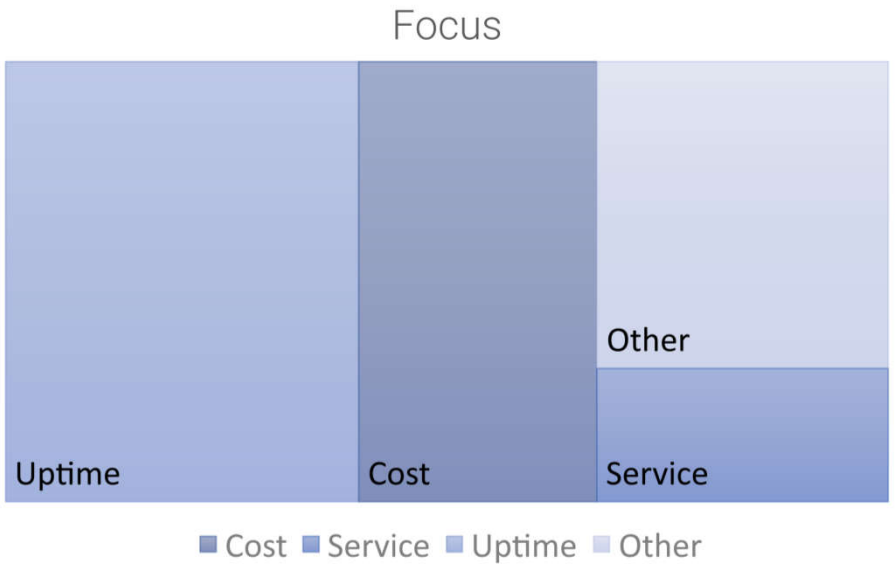
- What is the probability of this scenario affecting the operation?
- How will it affect them?
- How can this be mitigated?
- Is redundancy a part of a solution?



Exercise 2 – Considerations

<u>What are you as a customer focused on / what are your constraints?</u>

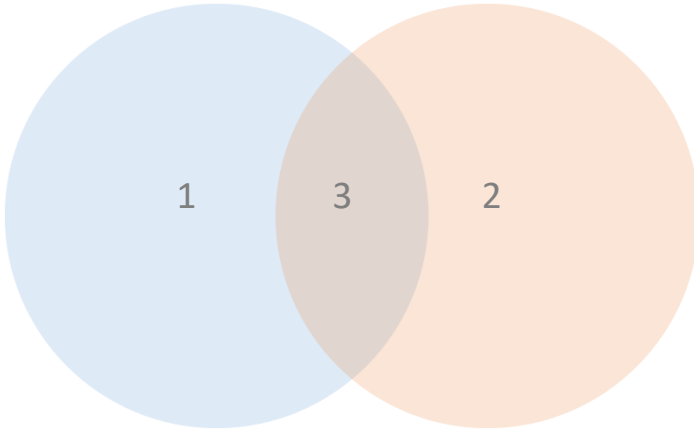
- Cost
- Serviceability
- Uptime
- Other



Exercise 3 – Solutions

Evaluation Criteria

- What solution best mitigates your resiliency scenario?
- What solution best fits your constraints?
- Is there a middle ground solution?
- Reevaluate with alternative solutions!



Lessons Learned

- Early planning saves time and money
- Create achievable goals for each project, upgrade, or service visit
- Avoiding single points of failure when practical
- Keep it simple – startup / troubleshooting / serviceability
- Documentation and Communication is critical for long term success

Questions?

LEADING THE WAY
CampusEnergy2022
Feb.15-18 Westin Boston Seaport District Hotel Boston, MA

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Thank You!

Grant Selking

Director, Midwest Region

Grant.Selking@thermosystems.com

Haig Monokian, P.E.

Engineering Team Lead

Haig.Monokian@thermosystems.com

Grant Kircher

Account Manager

Grant.Kircher@thermosystems.com

THERMO SYSTEMS

INDUSTRIAL AUTOMATION & INFORMATION

www.thermosystems.com