IMPROVING WWTP SAFETY BY COMPLYING WITH NFPA 820 & NFPA 70E

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Today's Speakers

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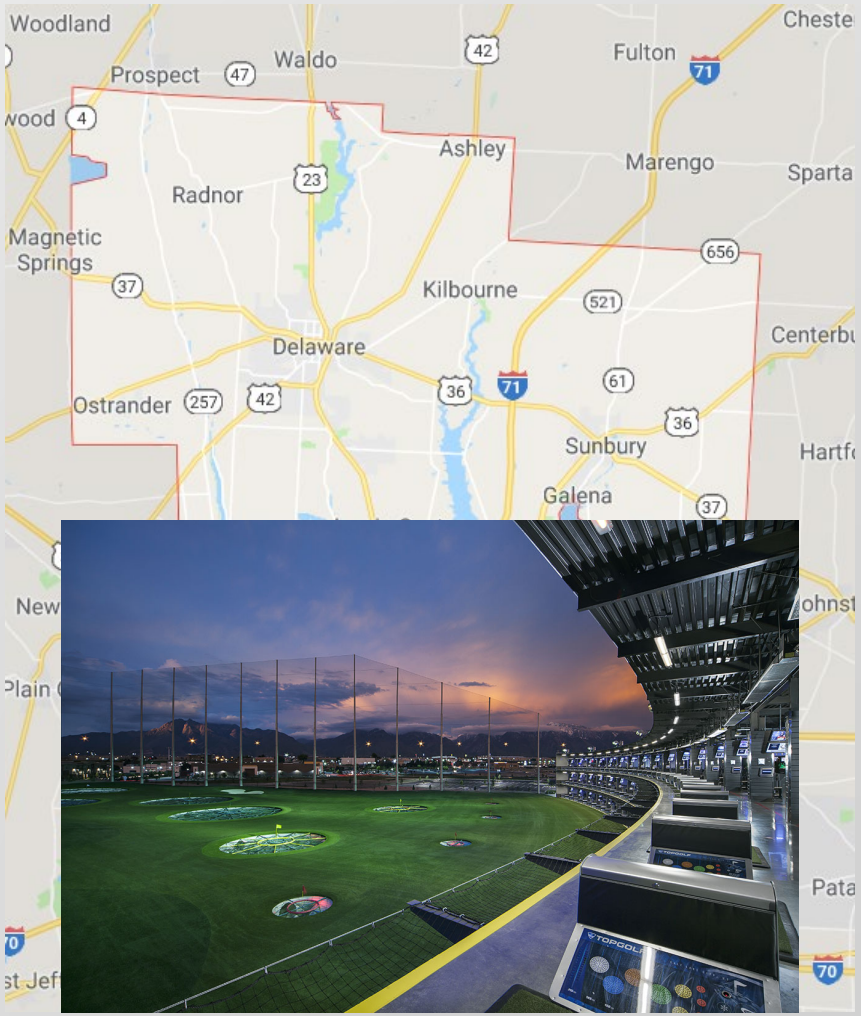
Delaware County

Ohio's Fastest Growing County

- Forecasts project 2035 population to be *54% greater* than in the 2010 census, an *average of 7% annual growth*.

Tanger Outlets

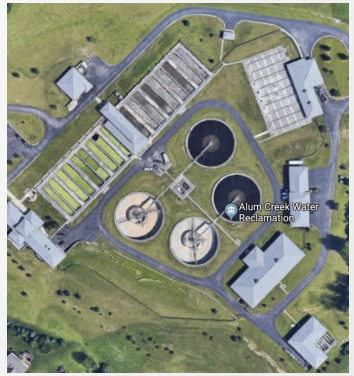
Alum Creek



Top Golf

Delaware County Regional Sewer District

OECC



Alum Creek

Lower Scioto

Northstar

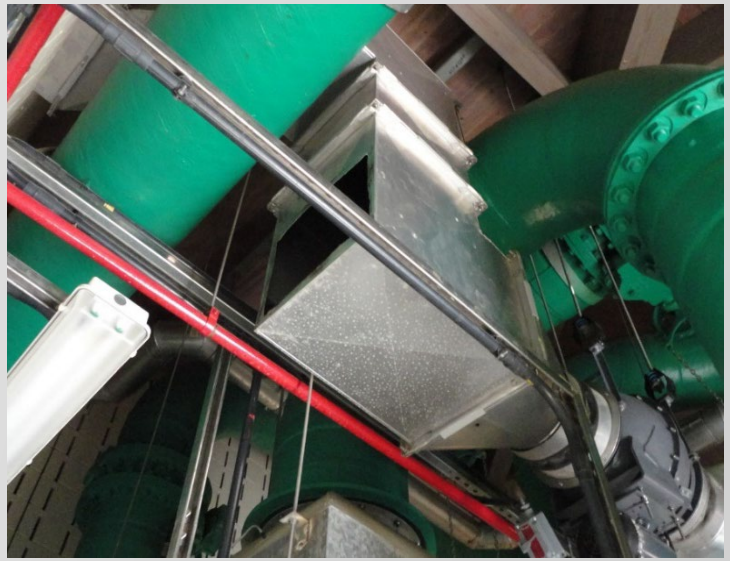
4 WWTPs

5 Package Plants

27 Pump Stations

Are Our Facilities Safe?

- Identifying areas of concern
- Building code reviews
- Employee safety
- Equipment protection
- Reclassification of spaces



Well, Let's See.

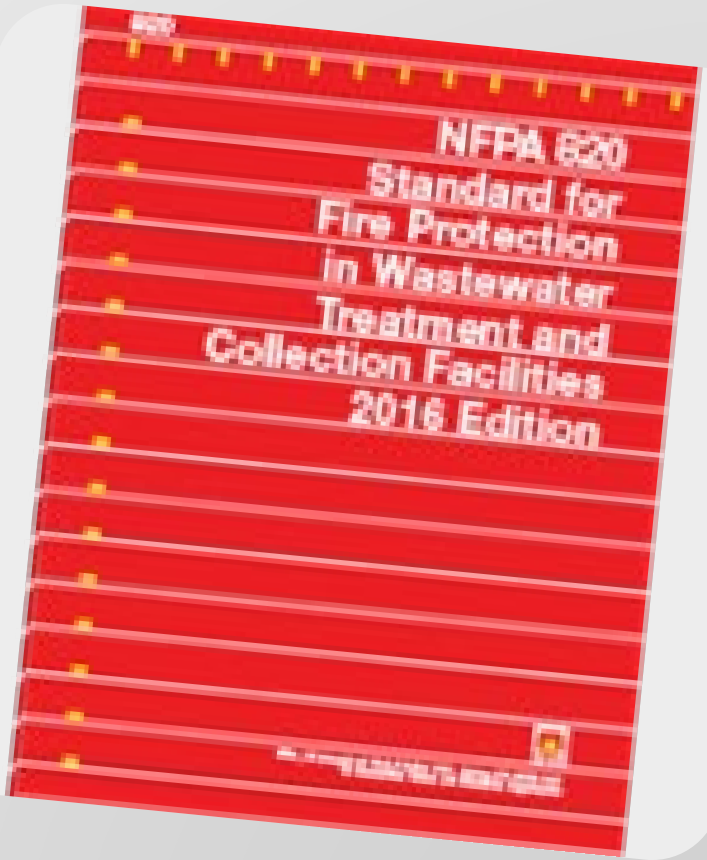
Project Goals:

- Review all facilities for NFPA 820 compliance (2016 Edition).
- Comprehensive evaluation of Electrical Safety Program including Arc Flash Analysis at all facilities.
- Properly educate and train staff.
- Establish safe work environment.

NFPA 820 – Standard for Fire Protection in Wastewater and Collection Facilities

What is NFPA 820?

- **Purpose:**
  - Provide a degree of fire and explosion protection and reduce or eliminate the effects of fire or explosion at wastewater collection, transportation, and treatment facilities.
- **Application:**
  - ❑ New installations
  - ❑ Additions or modifications made to existing facilities
  - ❑ Used by owners to perform risk assessment in existing facilities
  - ❑ NFPA 820 is a standard referenced by the National Electric Code



What is NFPA 820?

- **Retroactive:**
  - Not retroactive for installation prior to effective date of standard (1995).
  - AHJ shall be permitted to retroactively apply standard.
  - AHJ can approve variations if AHJ considers requirements impractical and “reasonable degree of safety” is provided.
- **Annex A – Explanatory Material (Informational):**
  - NFPA 820 application not always practical if disproportionate effort or expense with little increase to fire protection
  - Note intended to modify conditions that do not pose a fire threat.
  - *AHJ needs to be satisfied that reasonable fire protection is ensured.*

What is NFPA 820?

- Provides Hazard Classification
- NEC establishes the requirements for equipment in various classifications
- WWTPs are covered under Class I – Flammable Gases/Vapors
  - Division 1 – Hazard present during ***normal*** operating conditions
  - Division 2 – Hazards present during ***abnormal*** operating conditions
  - Unclassified – Hazards not present during normal operating conditions

Row[a]	Line[a]	Location and Function	Fire and Explosion Hazard	Ventilation[b]	Extent of Classified Area	*NEC* Area Electrical Classification (All Class I, Group D)	Materials of Construction[c]	Fire Protection Measures
16	a	WASTEWATER PUMPING STATION WET WELLS Liquid side of a pumping station serving a sanitary sewer or combined system	Possible ignition of flammable gases and floating flammable liquids	A	Entire room or space	Division 1	NC, LC, or LFS	CGD required if mechanically ventilated or opens into a building interior
	b			B	Entire room or space	Division 2	NC, LC, or LFS	CGD

NFPA 820 Table Example

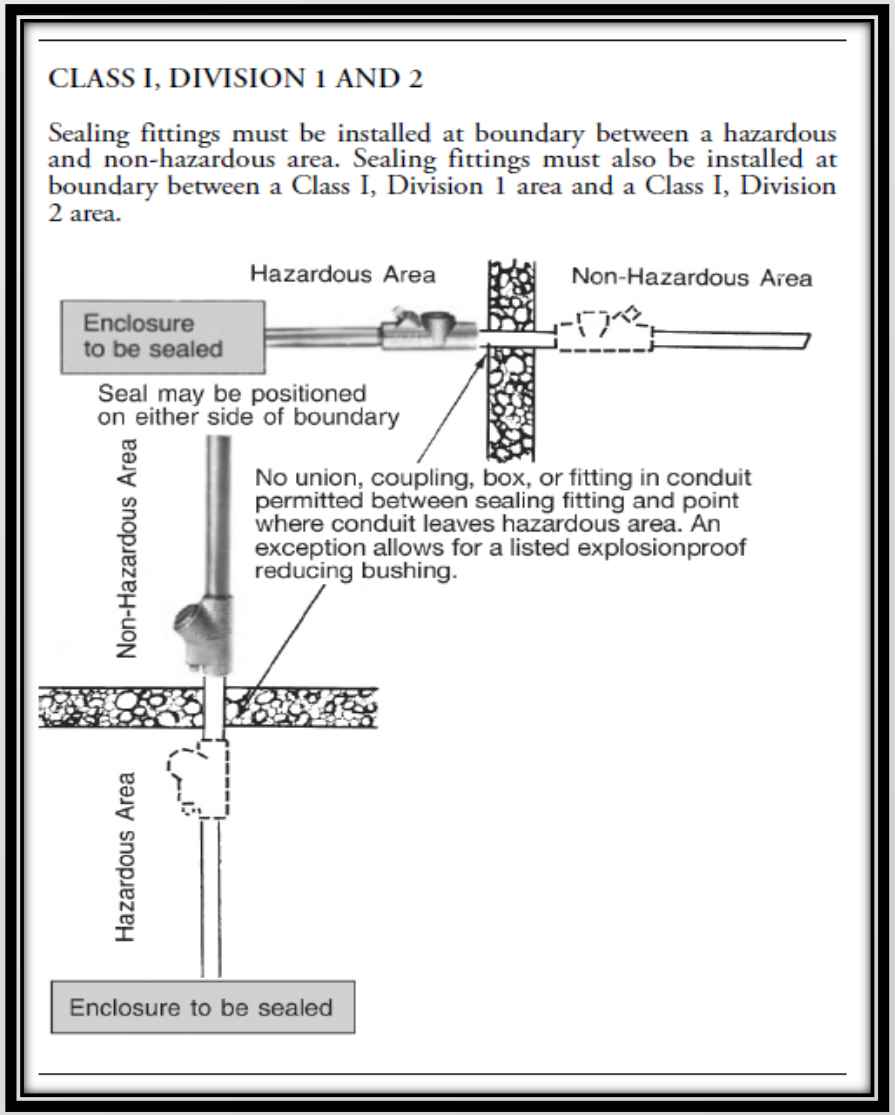
A:<12 AC/Hr or NV

B:12 AC/Hr

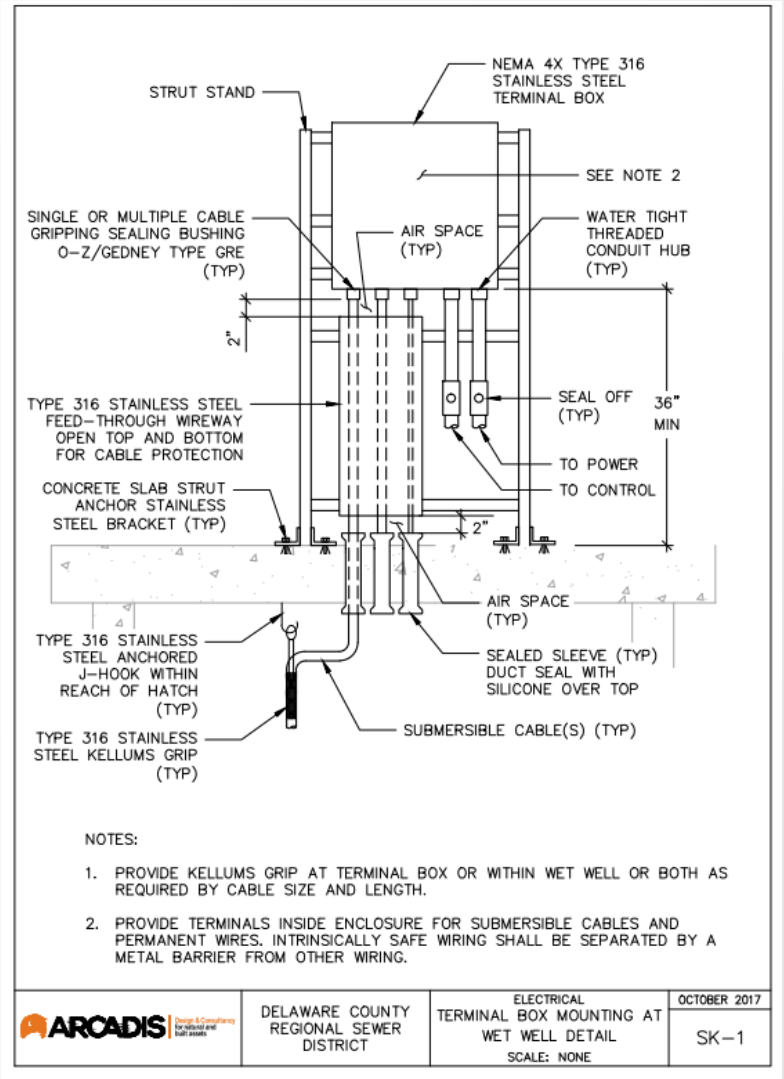
CGD: Combustible gas detection

Leading Non-Compliance Issues

- **Sealing Fittings:**
  - Prevents migration of gasses within the conduit system
  - Prevents spread of flame and gases from enclosures
  - Required when any conduit crosses boundary between D1 and D2 areas
  - Required between D1/D2 area and unclassified area



Wet Well Detail



Terminal Box Installation Example

Leading Non-Compliance Issues

- **Combustible Gas Detection System:**
  - Required in residential pump station wet wells
  - Required in sanitary/combined sewers wet wells if mechanically ventilated
  - Required in screening and solids handling buildings
  - Auxiliary power source required
  - Alarming and monitoring required
  - Testing and Calibration

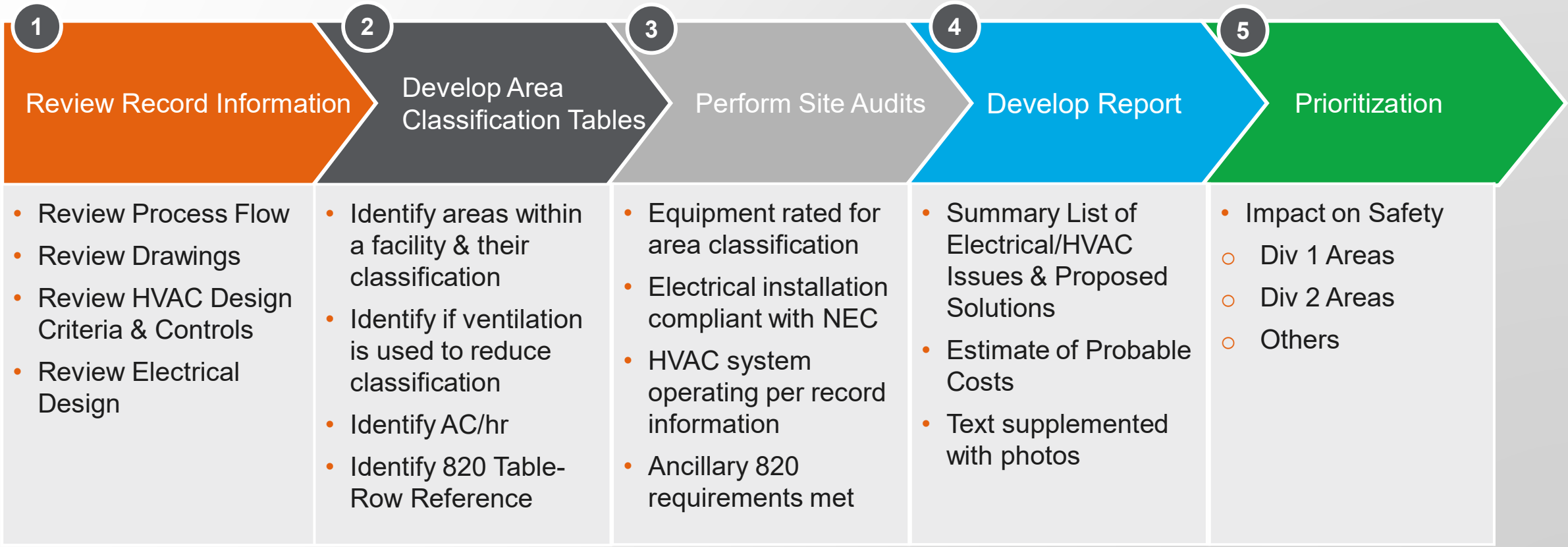
Leading Non-Compliance Issues

- **Ventilation Monitoring (reduce classification):**
  - Monitoring either not provided or not provided on both the supply and return air system when used to reduce the space classification.
  - Alarms not provided to signal ventilation failure, remote signal not provide, or alarm signaling not provided at correct locations.

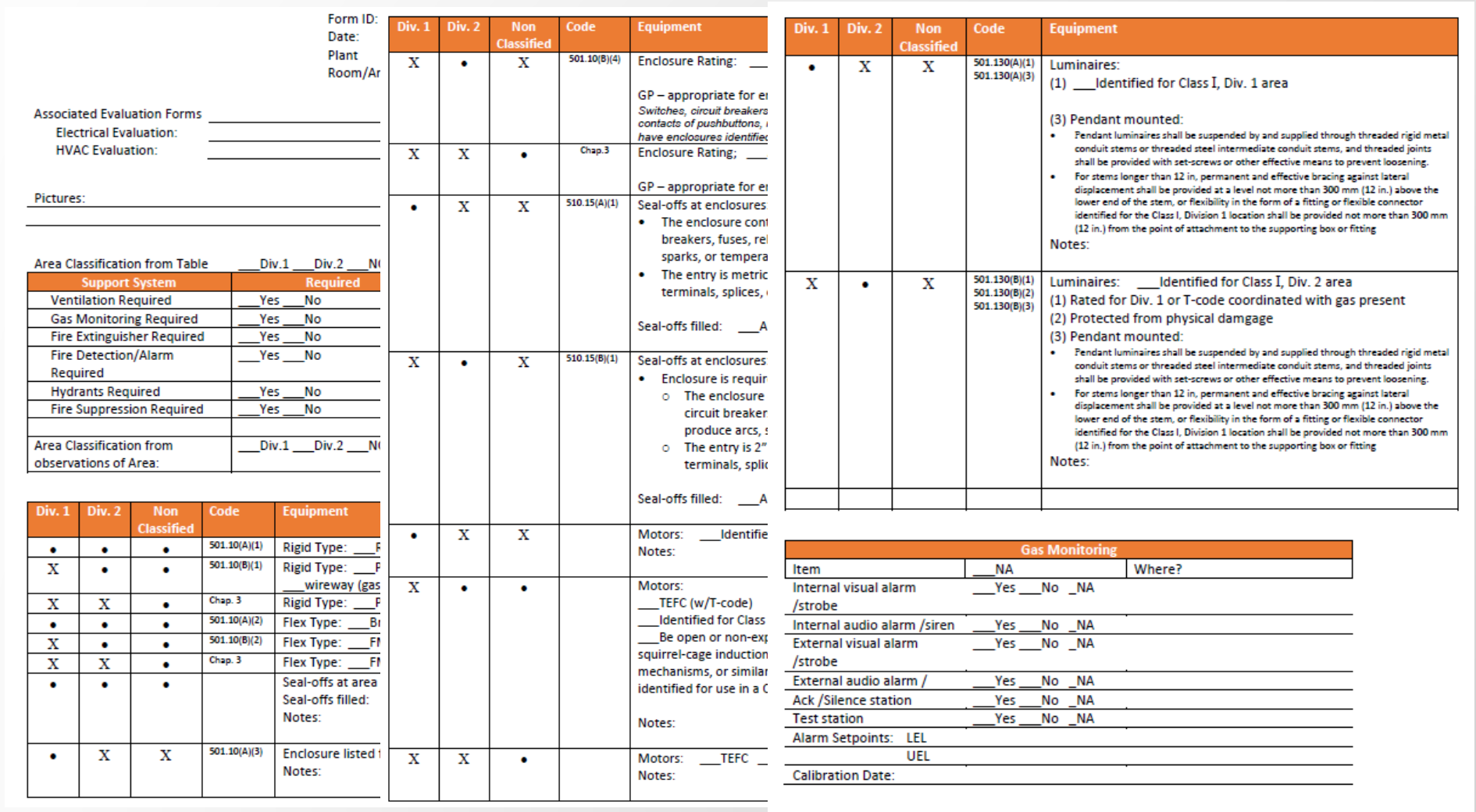
Leading Non-Compliance Issues

- **Inadequate Ventilation**
  - Ventilation was found to be intermittent when required to be continuous.
  - Air change per hour rate was not enough to reduce space classification
  - Ventilation does not encourage removal of both heavier than and lighter than air gases/vapors.
  - Supply and exhaust fan not provided for regularly entered space.

DCRSD's Approach to NFPA 820 Evaluation



Tools used to Support NFPA 820 Evaluation



Form ID:
Date:
Plant
Room/Ar

Associated Evaluation Forms _____
Electrical Evaluation: _____
HVAC Evaluation: _____

Pictures: _____

Area Classification from Table ___Div.1 ___Div.2 ___N

Support System	Required
Ventilation Required	___Yes ___No
Gas Monitoring Required	___Yes ___No
Fire Extinguisher Required	___Yes ___No
Fire Detection/Alarm Required	___Yes ___No
Hydrants Required	___Yes ___No
Fire Suppression Required	___Yes ___No
Area Classification from observations of Area:	___Div.1 ___Div.2 ___N

Div. 1	Div. 2	Non Classified	Code	Equipment
•	•	•	501.10(A)(1)	Rigid Type: ___F
X	•	•	501.10(B)(1)	Rigid Type: ___F ___wireway (gas
X	X	•	Chap. 3	Rigid Type: ___F
•	•	•	501.10(A)(2)	Flex Type: ___Bı
X	•	•	501.10(B)(2)	Flex Type: ___FI
X	X	•	Chap. 3	Flex Type: ___FI
•	•	•		Seal-offs at area Seal-offs filled: Notes:
•	X	X	501.10(A)(3)	Enclosure listed Notes:

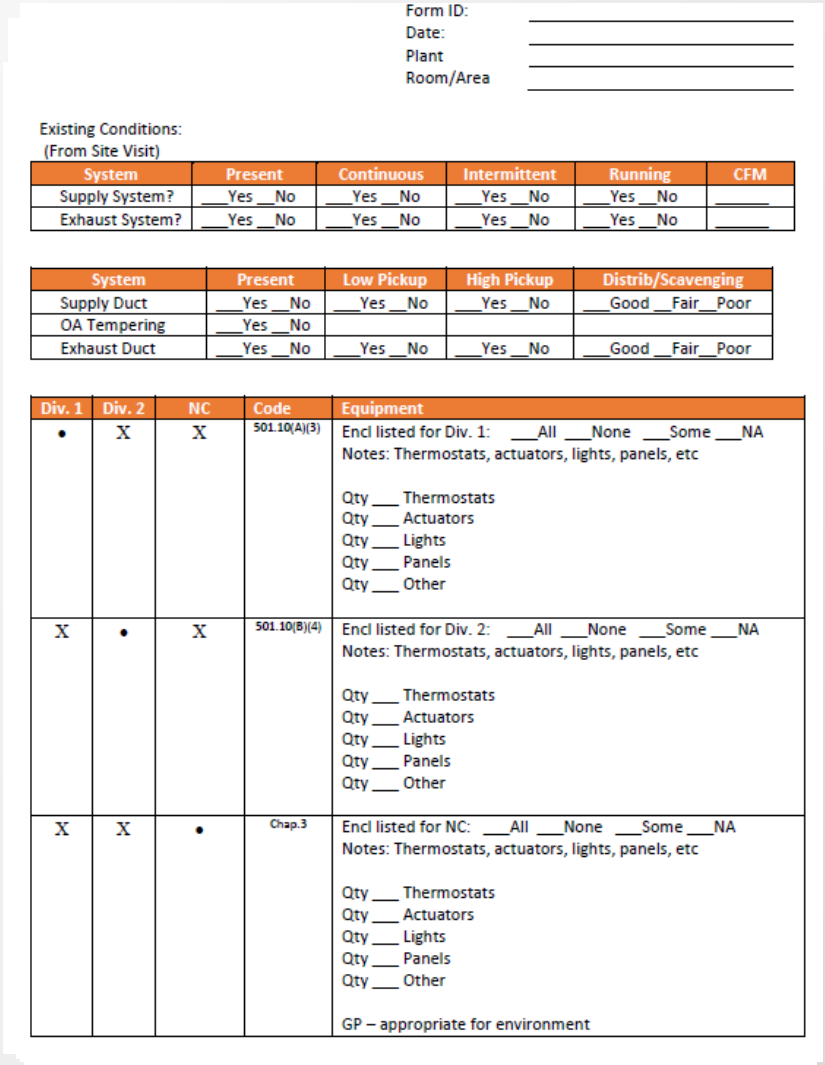
Div. 1	Div. 2	Non Classified	Code	Equipment
X	•	X	501.10(B)(4)	Enclosure Rating: ___ GP – appropriate for e *Switches, circuit breakers* *contacts of pushbuttons,* *have enclosures identifie*
X	X	•	Chap.3	Enclosure Rating; ___ GP – appropriate for e
•	X	X	510.15(A)(1)	Seal-offs at enclosures • The enclosure cont breakers, fuses, rel sparks, or tempera • The entry is metric terminals, splices, Seal-offs filled: ___A
X	•	X	510.15(B)(1)	Seal-offs at enclosures • Enclosure is requir ○ The enclosure circuit breaker produce arcs, ○ The entry is 2" terminals, splic Seal-offs filled: ___A
•	X	X		Motors: ___Identifie Notes:
X	•	•		Motors: ___TEFC (w/T-code) ___Identified for Class ___Be open or non-exp squirrel-cage induction mechanisms, or similar identified for use in a C Notes:
X	X	•		Motors: ___TEFC Notes:

Div. 1	Div. 2	Non Classified	Code	Equipment
•	X	X	501.130(A)(1) 501.130(A)(3)	Luminaires: (1) ___Identified for Class I, Div. 1 area (3) Pendant mounted: • Pendant luminaires shall be suspended by and supplied through threaded rigid metal conduit stems or threaded steel intermediate conduit stems, and threaded joints shall be provided with set-screws or other effective means to prevent loosening. • For stems longer than 12 in, permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in.) above the lower end of the stem, or flexibility in the form of a fitting or flexible connector identified for the Class I, Division 1 location shall be provided not more than 300 mm (12 in.) from the point of attachment to the supporting box or fitting Notes:
X	•	X	501.130(B)(1) 501.130(B)(2) 501.130(B)(3)	Luminaires: ___Identified for Class I, Div. 2 area (1) Rated for Div. 1 or T-code coordinated with gas present (2) Protected from physical damgage (3) Pendant mounted: • Pendant luminaires shall be suspended by and supplied through threaded rigid metal conduit stems or threaded steel intermediate conduit stems, and threaded joints shall be provided with set-screws or other effective means to prevent loosening. • For stems longer than 12 in, permanent and effective bracing against lateral displacement shall be provided at a level not more than 300 mm (12 in.) above the lower end of the stem, or flexibility in the form of a fitting or flexible connector identified for the Class I, Division 1 location shall be provided not more than 300 mm (12 in.) from the point of attachment to the supporting box or fitting Notes:

Gas Monitoring		
Item	___NA	Where?
Internal visual alarm /strobe	___Yes ___No _NA	
Internal audio alarm /siren	___Yes ___No _NA	
External visual alarm /strobe	___Yes ___No _NA	
External audio alarm /	___Yes ___No _NA	
Ack /Silence station	___Yes ___No _NA	
Test station	___Yes ___No _NA	
Alarm Setpoints: LEL		
UEL		
Calibration Date:		

NFPA 820 Inspection Electrical Checklist

Tools used to Support NFPA 820 Evaluation



Form ID: _____
Date: _____
Plant _____
Room/Area _____

Existing Conditions:
(From Site Visit)

System	Present	Continuous	Intermittent	Running	CFM
Supply System?	___Yes __No	___Yes __No	___Yes __No	___Yes __No	_____
Exhaust System?	___Yes __No	___Yes __No	___Yes __No	___Yes __No	_____

System	Present	Low Pickup	High Pickup	Distrib/Scavenging
Supply Duct	___Yes __No	___Yes __No	___Yes __No	___Good __Fair__Poor
OA Tempering	___Yes __No			
Exhaust Duct	___Yes __No	___Yes __No	___Yes __No	___Good __Fair__Poor

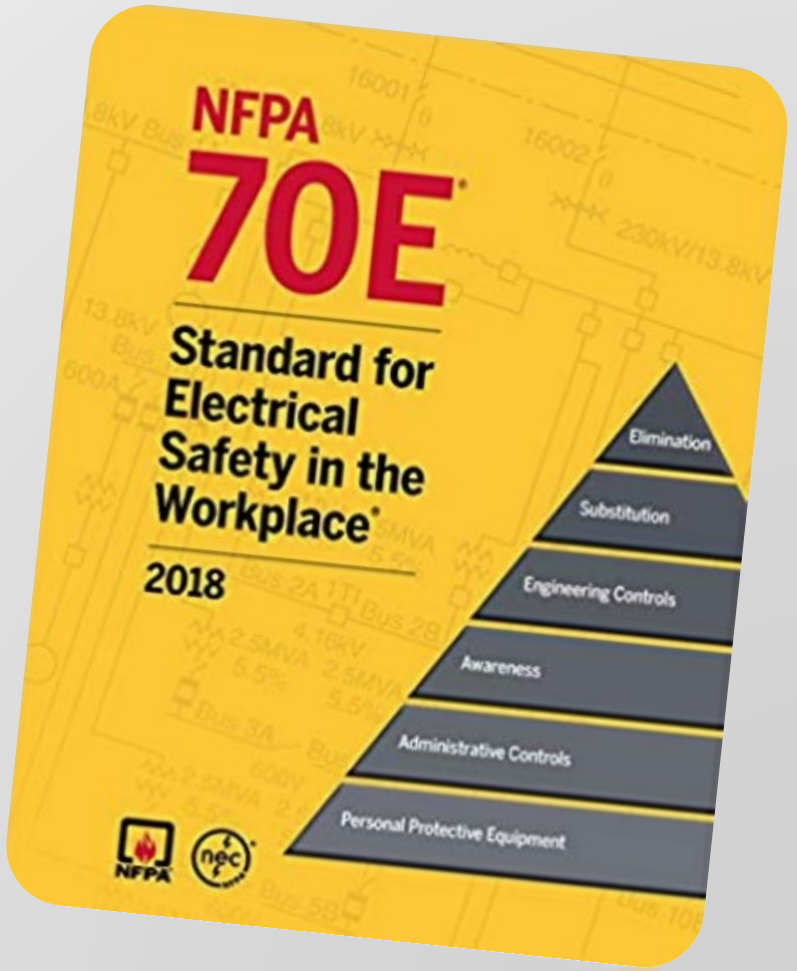
Div. 1	Div. 2	NC	Code	Equipment
•	X	X	501.10(A)(3)	Encl listed for Div. 1: ___All ___None ___Some ___NA Notes: Thermostats, actuators, lights, panels, etc Qty ___ Thermostats Qty ___ Actuators Qty ___ Lights Qty ___ Panels Qty ___ Other
X	•	X	501.10(B)(4)	Encl listed for Div. 2: ___All ___None ___Some ___NA Notes: Thermostats, actuators, lights, panels, etc Qty ___ Thermostats Qty ___ Actuators Qty ___ Lights Qty ___ Panels Qty ___ Other
X	X	•	Chap.3	Encl listed for NC: ___All ___None ___Some ___NA Notes: Thermostats, actuators, lights, panels, etc Qty ___ Thermostats Qty ___ Actuators Qty ___ Lights Qty ___ Panels Qty ___ Other GP – appropriate for environment

NFPA 820 Inspection HVAC Checklist

NFPA 70E – Standard for Electrical Safety in the Workplace

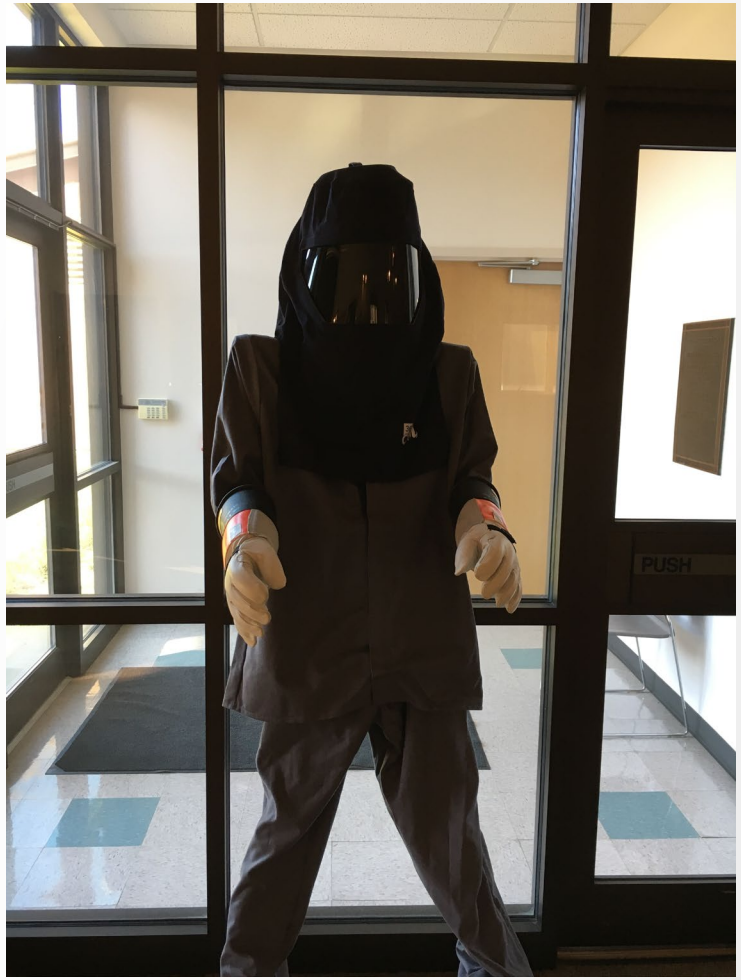
What is NFPA 70E?

- **Purpose:**
  - Provides a working area for employees that is safe from unacceptable risk associated with the use of electricity in the workplace.
  - NFPA 70E establishes safety processes that use policies, procedures, and program controls to reduce the risk associated with the use of electricity to an acceptable level.
  - The core objective is practical, accomplishable electrical safety that results in the employee going home safe at the end of the day.



Arc Flash Incident (Video)

NFPA 70E Compliance - Electrical Safety Program



- NFPA 70E is not just Arc Flash!
- De-energizing Policy
- Lockout/Tagout (LOTO)
- Energized Work Policies
- PPE
- Inspection, Testing and Care of PPE
- Training and Retraining
- Auditing Safety Program
- Record Keeping
- Maintenance Requirements

How Did We Get The Arc Flash Labels?

1 Review Record Information	2 Prepopulate Data Sheets	3 Perform Site Audits	4 Develop Model & Run Analysis	5 Install AF Labels & Update Settings
• Review Drawings • Review previous arc flash studies	• Minimize downtime • Equipment names • Equipment ratings • CB Amperage • Motor HP • Feeder Size & Type • Feeder Length	• Confirm one-line diagram • Collect data in de-energized state (OSHA) • Coordination with DCRSD staff • Collecting Data is Crucial	• Short Circuit Study • Equipment Evaluation • Coordination Study • Arc Flash Analysis • Arc Flash Mitigation • Workshops • Report	• Critical that settings are verified and updated. Otherwise analysis is invalid • Outdoor label considerations

Tools used to Support NFPA 70E Analysis

Delaware County AF & NFPA 820 PROJECT
Field Data Collection Worksheet

Facility: Alum Creek Pump Station (NEW)
Equipment ID: 0

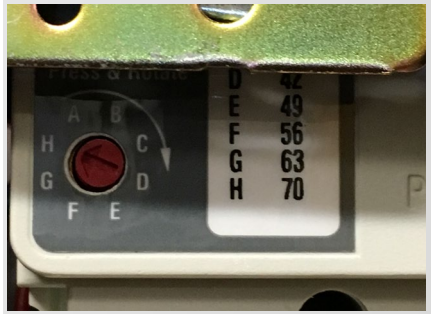
MCC ID: MCC-PS **MFG/Model:** AB CENTERLINE (2100)
Location: First Floor **Ratings:** 600V, 600A Bus

Motor Control Center - Data

No.	Equipment Supplied	Circuit Breaker MFG'r	Circuit Breaker Model	CB Trip Rating (A)	Instant Trip Setting (A)	Interrupt Rating (kA)	Motor HP	Feeder Size & Type	Feeder Length (feet) & Conduit Type	Notes
1	Dry Well Hoist/Trolley	Culter-Hammer	HFD3030L	30		65K	1.5	3#10, 1#10G	25 - RGS	
2	Wet Well Hoist/Trolley	Culter-Hammer	HFD3030L	30		65K	2	3#10, 1#10G	25 - RGS	
3	Spare Starter	Culter-Hammer	HMCP015B0CA02	15	A	65K				
4	Slucide Gate 1	Culter-Hammer	HFD3015L	15		65K	0.67	3#12, 1#12G	25 - RGS	
5	Slucide Gate 2	Culter-Hammer	HFD3015L	15		65K	0.67	3#12, 1#12G	25 - RGS	
6	Slucide Gate 3	Culter-Hammer	HFD3015L	15		65K	2	3#12, 1#12G	25 - RGS	
7	Grinder 1	Culter-Hammer	HFD3020L	20		65K	5	3#10, 1#10G	25 - RGS	
8	Grinder 2	Culter-Hammer	HFD3020L	20		65K	5.00	3#10, 1#10G	25 - RGS	
9	Lighting Contactor Panel	Culter-Hammer	HFD3030L	30		65K		3#10, 1#10G	25 - RGS	
10	XFMR T1-PS	Culter-Hammer	HFD3060L	60		65K	45KVA	4#6, 1#10G	25 - RGS	
11	Diesel Jacket Heaters	Culter-Hammer	HFD3030L	30		65K	10KW	3#10, 1#10G	25 - RGS	
12	Exhaust Fan 1	Culter-Hammer	HMCP015B0CA02	15	H	65K	5	3#12, 1#12G	25 - RGS	
13	Exhaust Fan 2	Culter-Hammer	HMCP007C0C	7	G	65K	3	3#12, 1#12G	25 - RGS	
14	Exhaust Fan 3	Culter-Hammer	HMCP007C0C	7	H	65K	3	3#12, 1#12G	25 - RGS	
15	Exhaust Fan 4	Culter-Hammer	HMCP007C0C	7	H	65K	3	3#12, 1#12G	25 - RGS	
16	Exhaust Fan 5	Culter-Hammer	HMCP007C0C	7	G	65K	3	3#12, 1#12G	25 - RGS	
17	Supply Fan 7	Culter-Hammer	HMCP030H1CA02	30	H	65K	20	3#6, 1#10G	25 - RGS	
18	Makeup Air Unit 1	Culter-Hammer	HFD3060L	60		65K	25	3#8, 1#8G	25 - RGS	
19	Makeup Air Unit 2	Culter-Hammer	HFD3030L	30		65K	10	3#10, 1#10G	25 - RGS	
20	Welding Recp XFMR	Culter-Hammer	HFD3040L	40		65K	15KVA	2#6, 1#10G	25 - RGS	
21	20" FM Iso Valve	Culter-Hammer	HFD3020L	20		65K	1.67	3#12, 1#12G	25 - RGS	
22	36" FM Iso Valve	Culter-Hammer	HFD3020L	20		65K	6.7	3#12, 1#12G	25 - RGS	

Field Data Collection Worksheet

Photos



Shutdown/Startup Procedures

Alum Creek and Leather Lips
Pump Station Shutdown Procedures

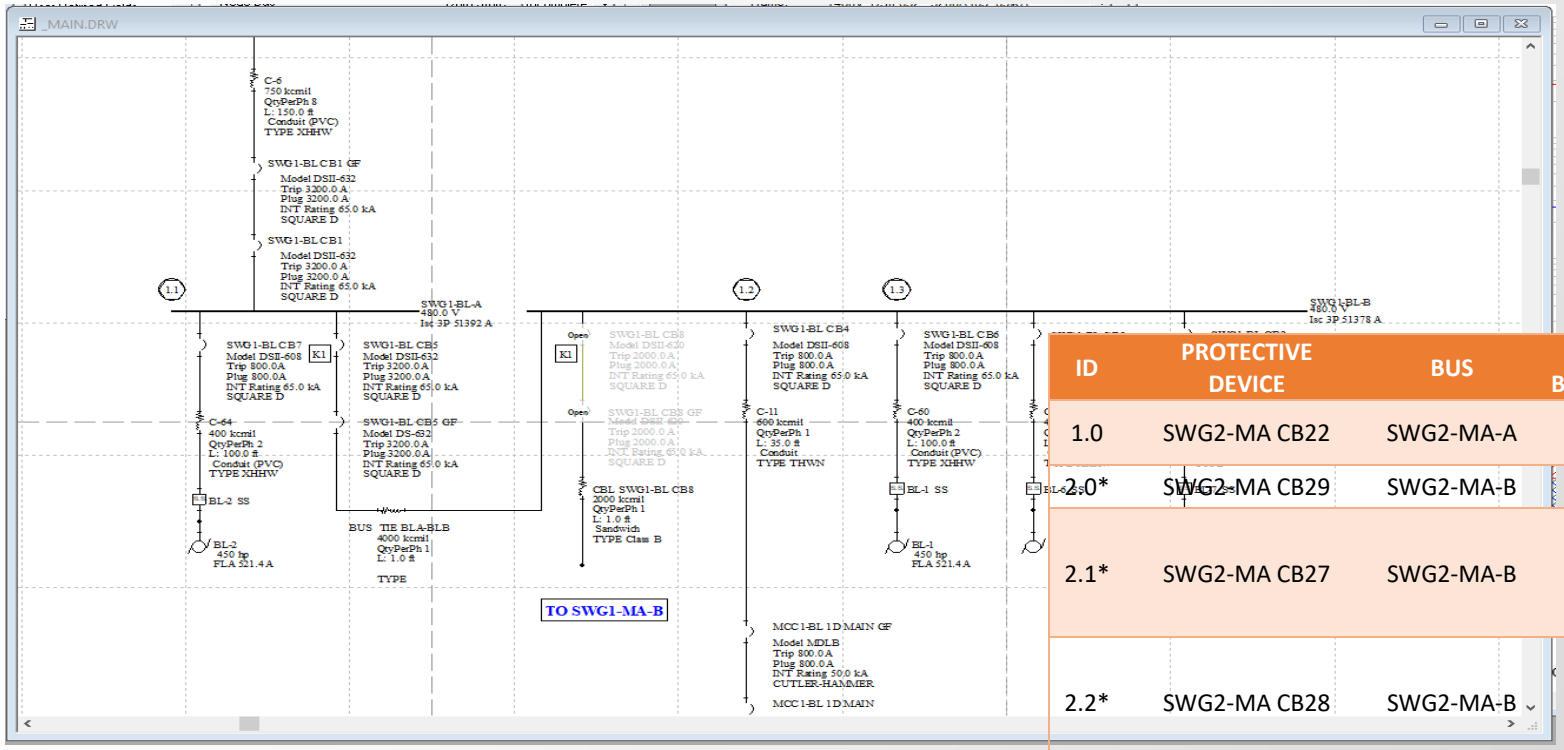
Shutdown Procedure

Step	Item	Responsible Party
1	Pump Wet Well Down	DCRSD
2	LOTO Generator Circuit Breaker	DCRSD, CAT 2 PPE
3	Set-Up Portable Lights	Arcadis
4	Open Main Circuit Breaker	DCRSD, CAT 2 PPE
5	Confirm MCC is de-energized with non-contact test (verify, test, verify)	DCRSD
6	Collect Data within Main Circuit Breaker Bucket	Arcadis
7	Close Main Circuit Breaker Bucket Door & LOTO	DCRSD
8	Monitor Wetwell Level (max duration of shutdown = 30 - 45mins)	DCRSD
9	Collect all other MCC Data	Arcadis
10	Collection Generator Data	Arcadis
11	Data Collection Finished	DCRSD/Arcadis

Startup Procedure

Step	Item	Responsible Party
1	Confirm all MCC buckets are secured	Arcadis
2	Place each pump selector switch in "off" position	Arcadis
3	Remove Lock on Main Circuit Breaker and Close	DCRSD, CAT 2 PPE
4	Place each pump selector switch in "auto" position	Arcadis
5	Remove Lock on Generator Circuit Breaker and Close	DCRSD, CAT 2 PPE
6	Remove Portable Lights	Arcadis
7	Pump Station Back Online	DCRSD/Arcadis

Tools used to Support NFPA 70E Analysis



SKM System Model

Finger area ~ 1cm^2

Candle heat ~ 1Cal

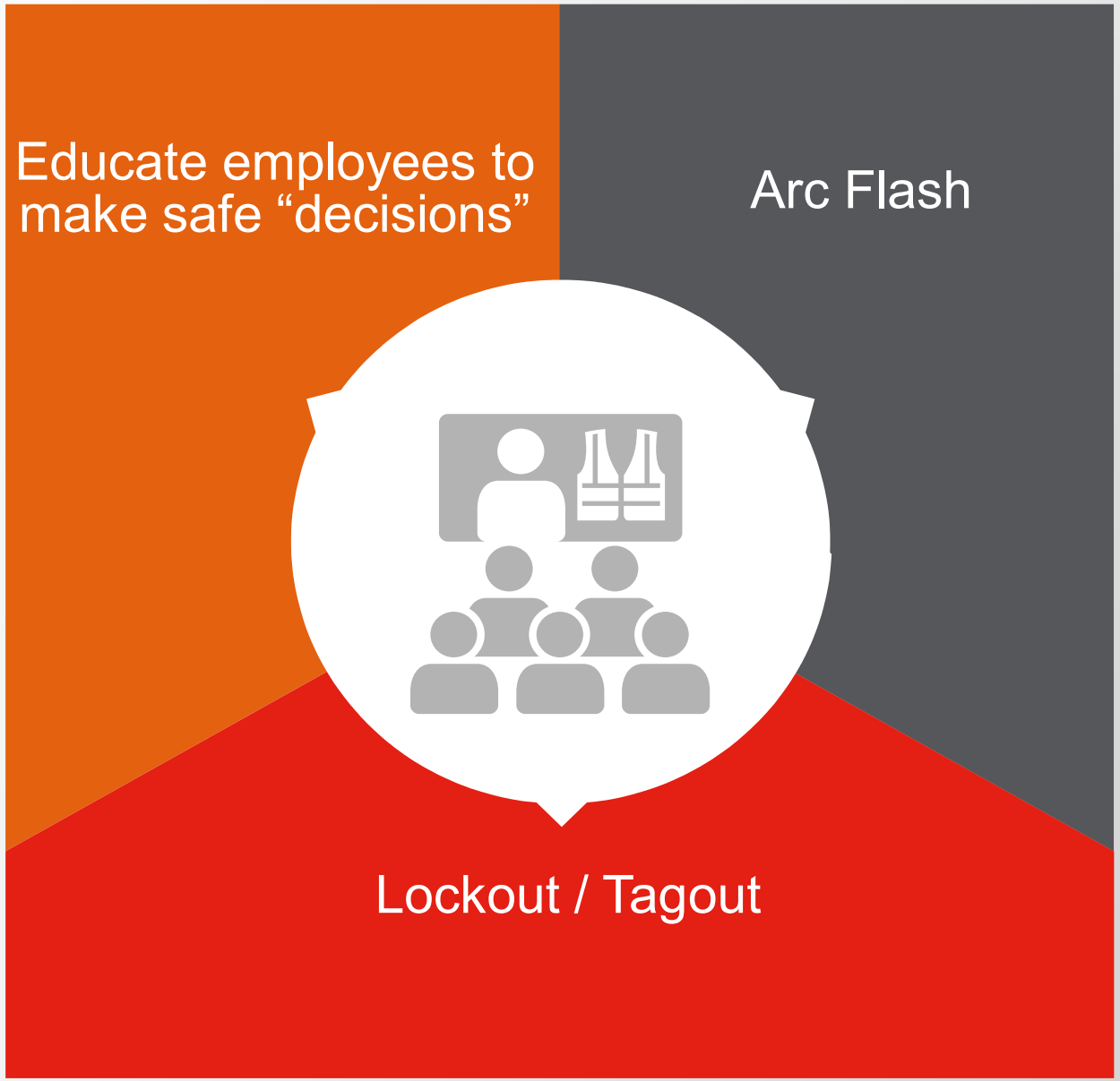
Arc Flash Mitigation Changes

ID	PROTECTIVE DEVICE	BUS	AF BEFORE	AF AFTER	SETTING	BEFORE	AFTER	NOTES
1.0	SWG2-MA CB22	SWG2-MA-A	21.9	10.6	STD	0.5	0.2	CONFLICT WITH CB26 (tie) SO ACCEPTABLE
2.0*	SWG2-MA CB29	SWG2-MA-B	15.8	11.6	STD	0.3	0.2	
2.1*	SWG2-MA CB27	SWG2-MA-B	-	-	STD	0.2	0.1	COORD WITH CB29; CREATES CONFLICT WITH MCC1-SH MAIN; ACCEPTABLE
2.2*	SWG2-MA CB28	SWG2-MA-B	-	-	STD	0.2	0.1	COORD WITH CB29; CREATES CONFLICT WITH MCC2-SH MAIN; ACCEPTABLE
3.0	SWG1-MA CB21	SWG1-MA B SWG2-MA A	32	-	STPU	-	-	SETTING ALREADY AT MINIMUM
4.0	ADMIN BLDG	MCC-AD lineside	42.1	5.54	STPU	S2(12)	6	MIS-COORD. WITH MCC-AD MAIN 5E BUT ACCEPTABLE SINCE IN SERIES

* These setting alterations must be performed as a unit; they cannot be applied separately.

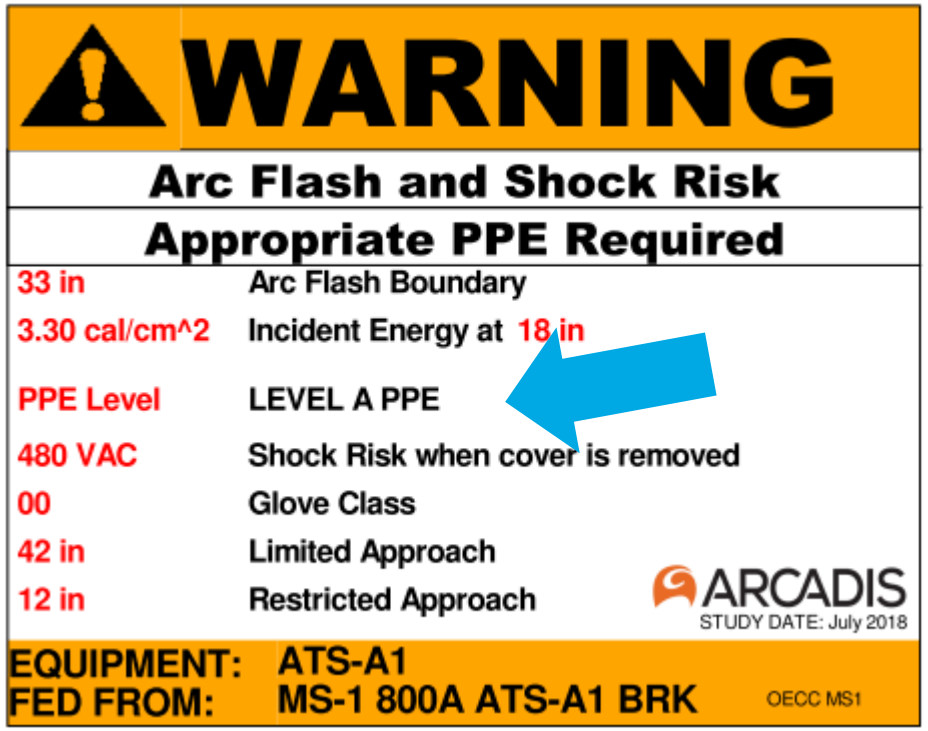
DCRSD ELECTRICAL SAFETY TRAINING

3-Proged Approach to Education



1. ALL DCRSD Staff Participated

2. Arc Flash Labels & PPE



Information from NFPA 70E 2018, Table 130.5(G).

Level A PPE - Incident energy exposures equal to 1.2 cal/cm2 up to 12 cal/cm²:

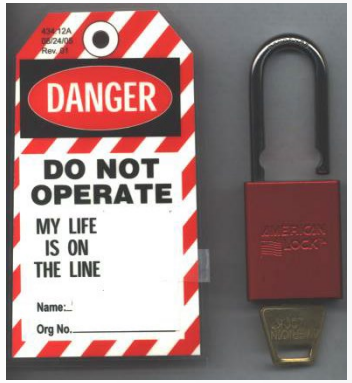
- Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy [a]
- Long-sleeve shirt and pants or coverall or arc flash suit (SR)
- Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) [b]
- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
- Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR) [c]
- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection
- Leather footwear

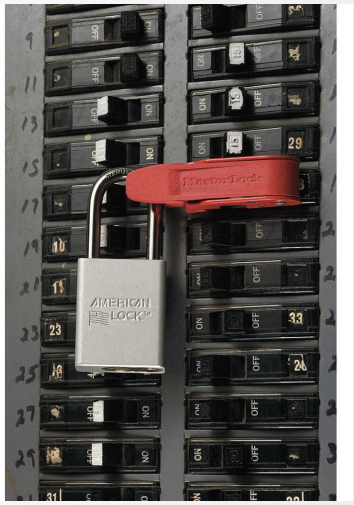
Level B PPE - Incident energy exposures greater than 12 cal/cm²:

- Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy [a]
- Long-sleeve shirt and pants or coverall or arc flash suit (SR)
- Arc-rated arc flash suit hood
- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
- Arc-rated gloves or rubber insulating gloves with leather protectors (SR)[c]
- Hard hat
- Safety glasses or safety goggles (SR)
- Hearing protection
- Leather footwear

SR: Selection of one in group is required.
AN: As needed.

3. Lockout/Tagout Protocol





Project Name:			Project Location:
Project Number:			Project Manager:
Developed By:			Reviewed By:
Origin Date:	Revision #:	Revision Date:	Revised By:
Equipment #:			Equipment Manufacture:
Equipment Description:			Equipment Location:

Warning: Only Authorized Employees who have been Trained and Authorized can perform the LOTO procedures below

Equipment Diagram

Insert photos of equipment or schematic showing location of equipment to be locked out

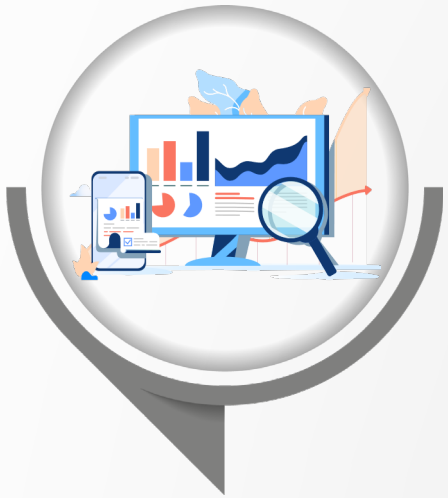
Adjacent & Associated Equipment

Adjacent & Associated Equipment	Location of Adjacent & Associated Equipment and Action to be Taken

Lockout Tagout (LOTO) Procedure

Energy Source	Lockout Device	Isolation Location	Lockout Method	Zero Energy Check, Verification & Testing

In Summary, We Encourage You to:



Establish a culture of safety

Incorporate electrical safety into all CIP projects & maintenance activities

Perform continuous evaluation and training

QUESTIONS?

ARCADIS Design & Consultancy for natural and built assets

DELAWARE COUNTY Ohio