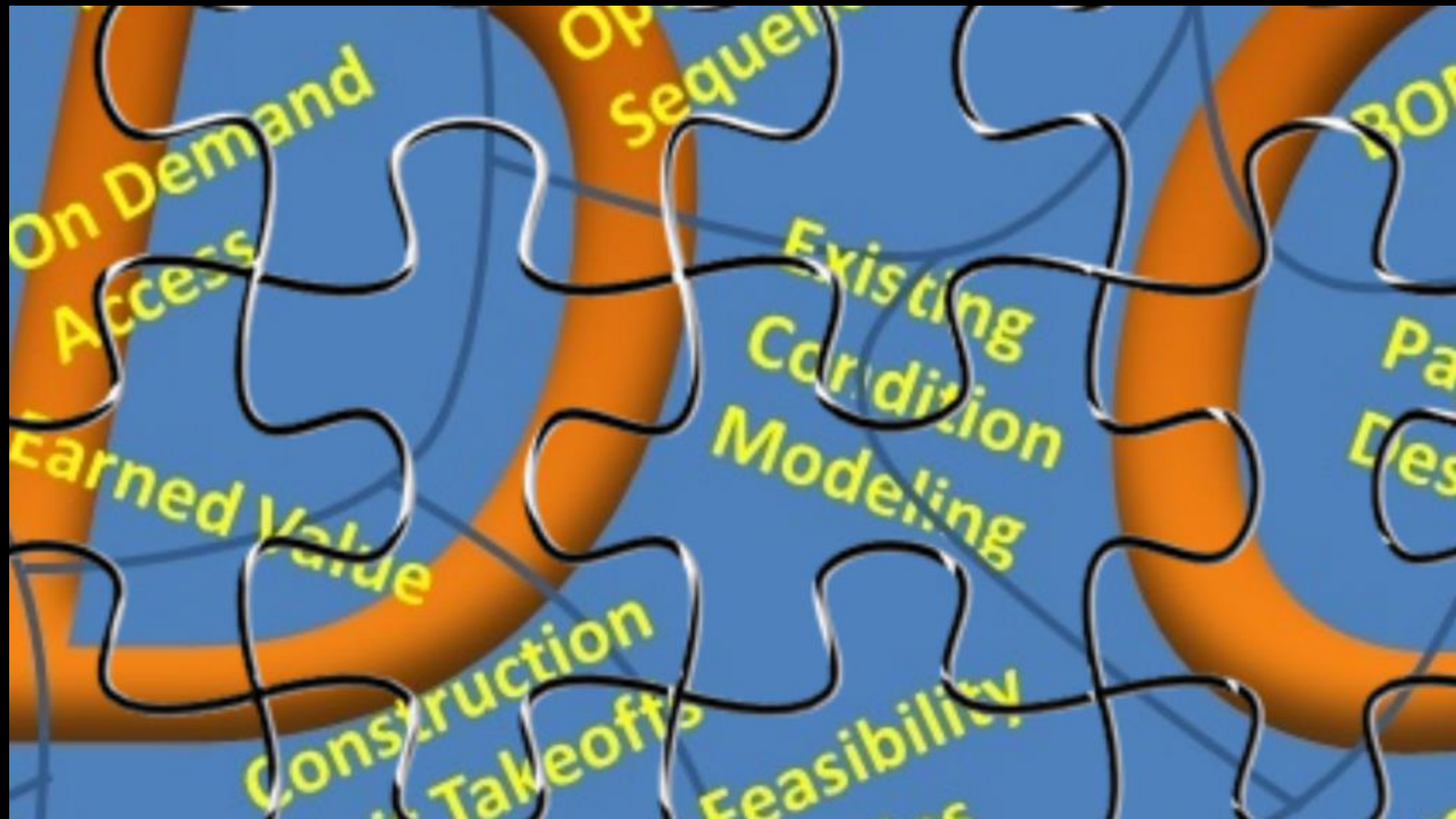




AEP's Experience
Using Integrated Design Construction and Prefabricated Construction

2018
11 YEARS IN REVIEW



Introduction

Bringing cost and schedule certainty to AEP Transmission projects by spearheading model-based design and IDC process in project planning and execution.

What? Why? When?

Construction labor is the highest cost category for our projects, and it has been trending up in recent years. To address these challenges, AEP utilized Building Information Modeling (BIM) on several pilot projects to improve cost efficiencies and further support construction safety, starting in 2016.

Primary Focus Areas



Existing Condition
Modeling

#1



Prefabrication

#4



Construction
Sequencing

#3



Model-Based
Design

#2

CONNECT IDEAS #1A

Majority of Work Involving
Brownfield Projects



Out of Date Legacy
Documentation







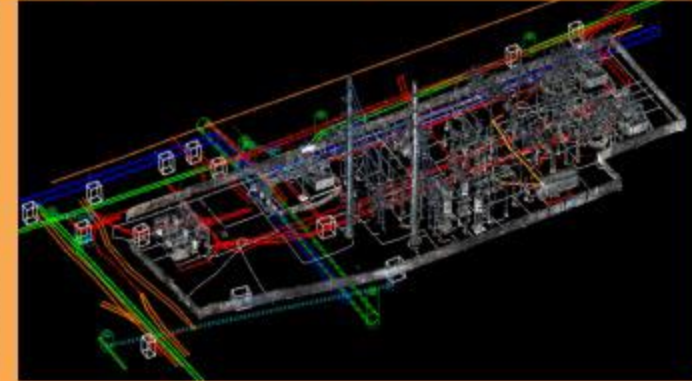
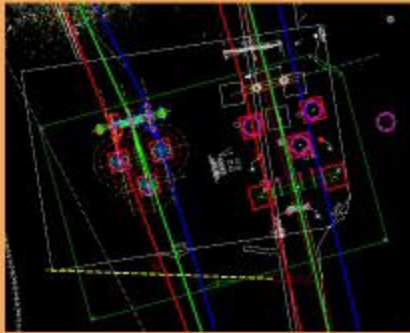
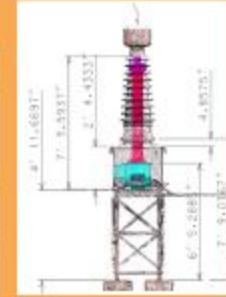
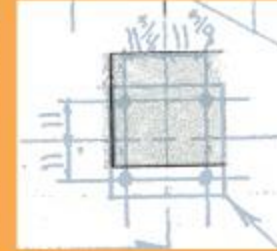
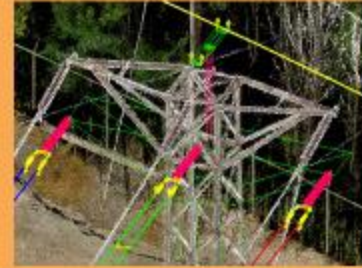


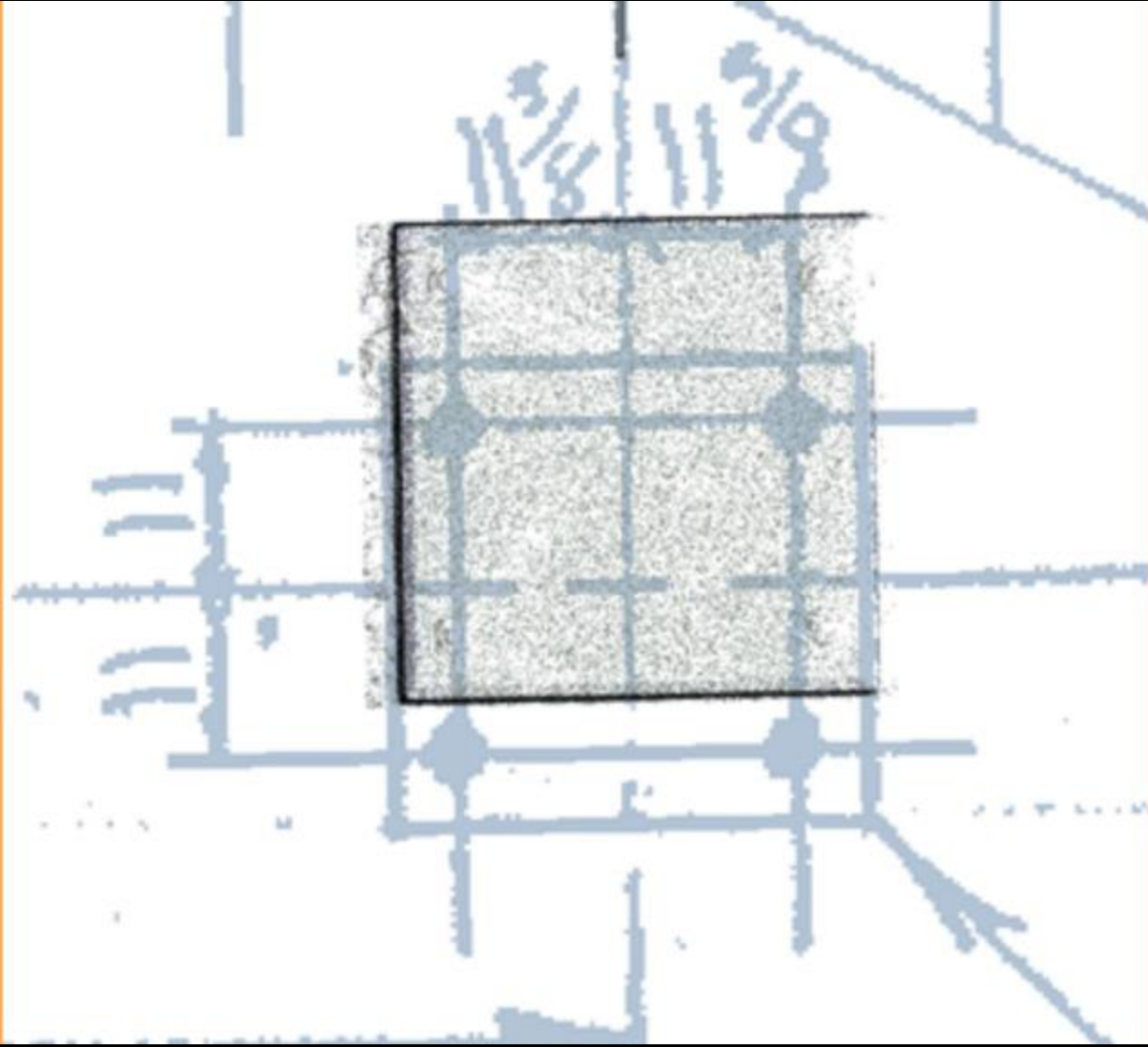
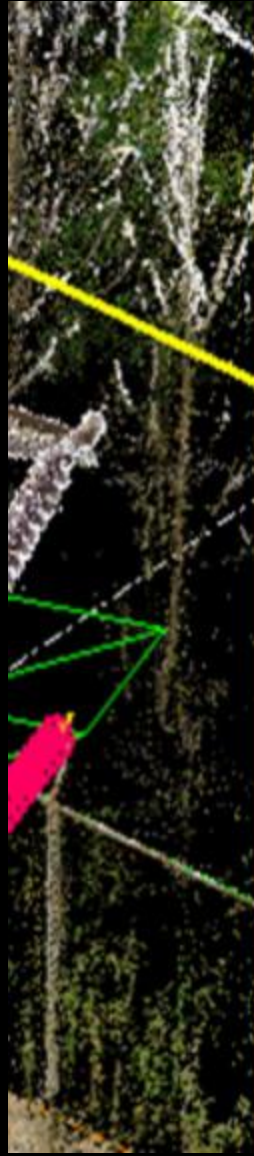
Make Connections #1B

Use of Existing
Condition Modeling



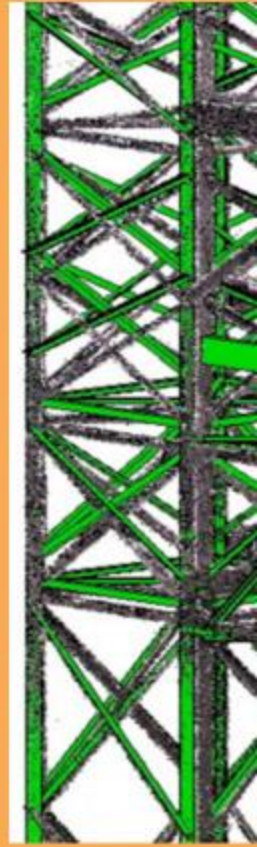
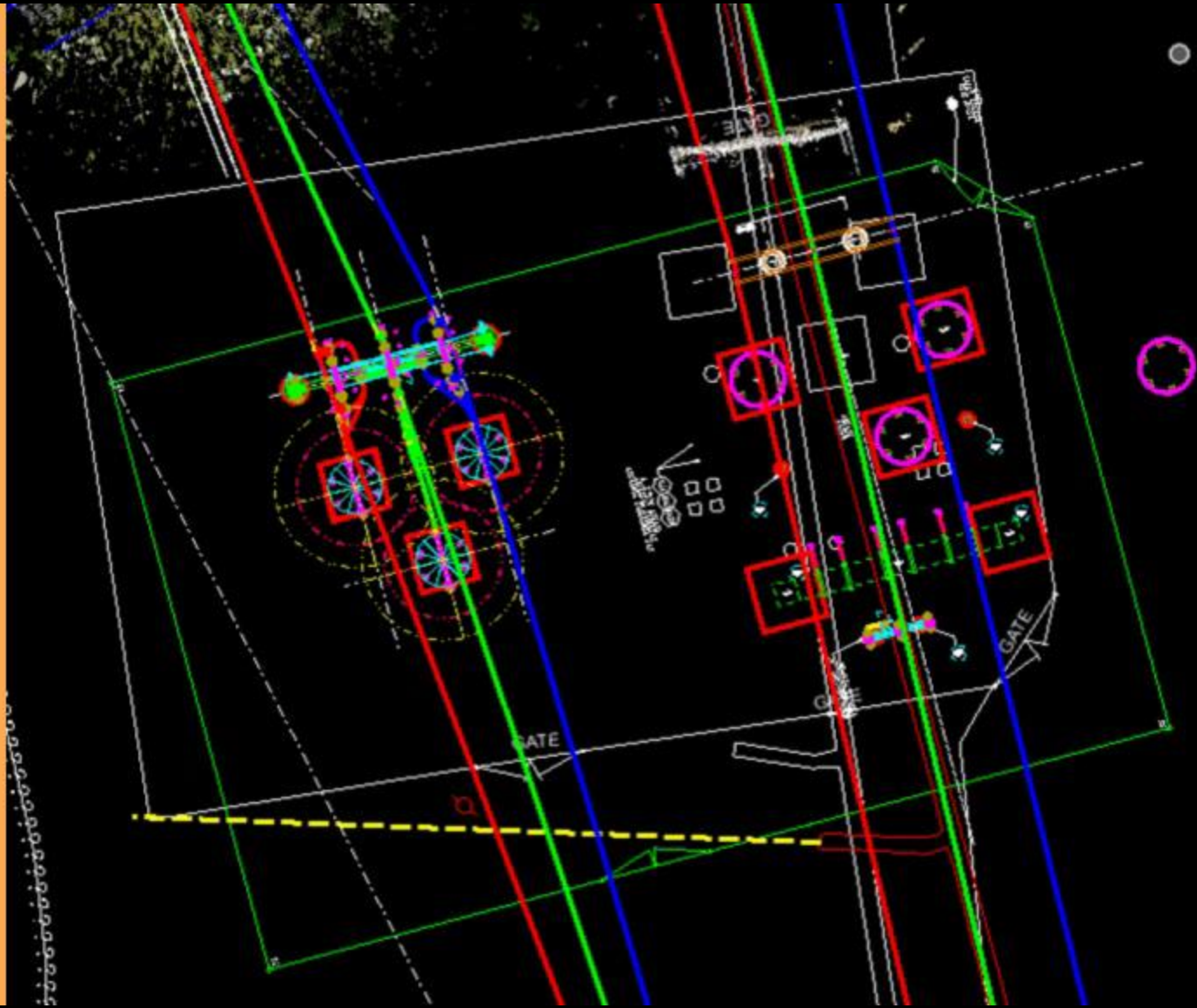
Fit for Purpose
Design

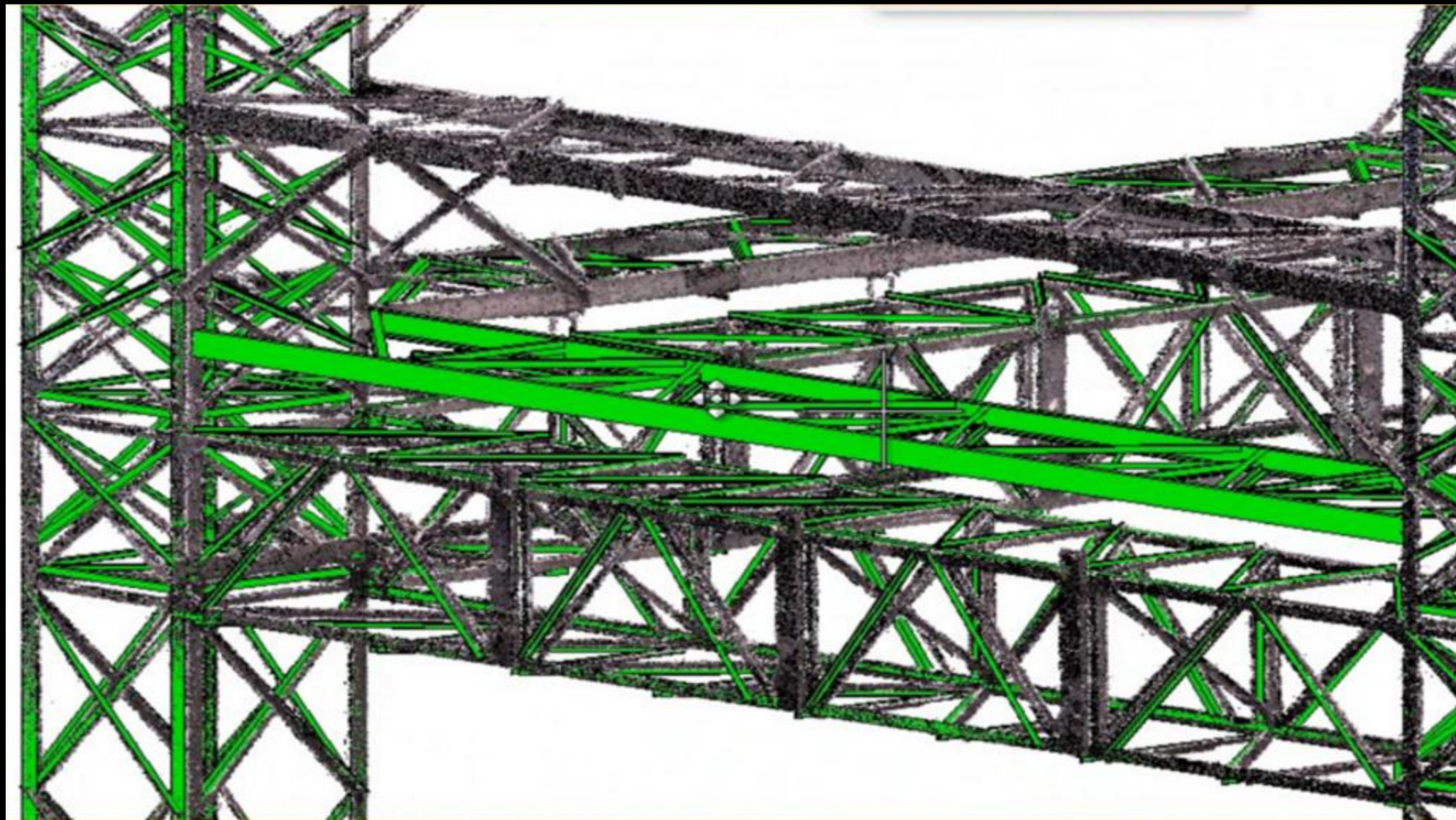


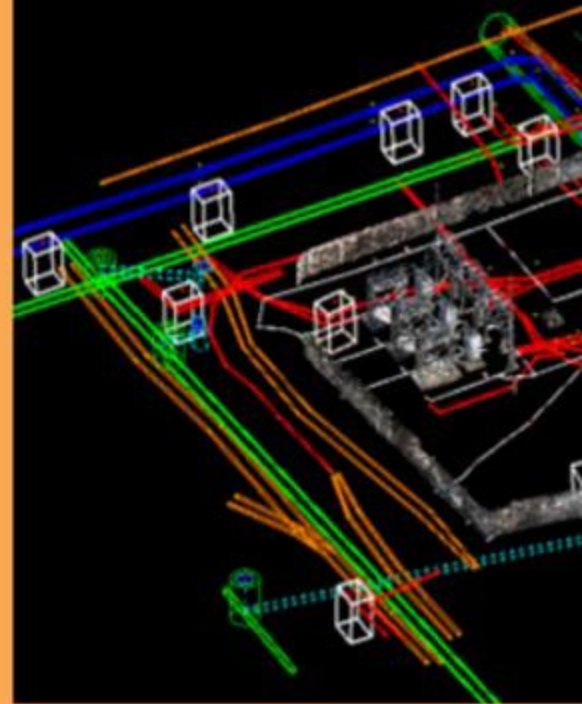
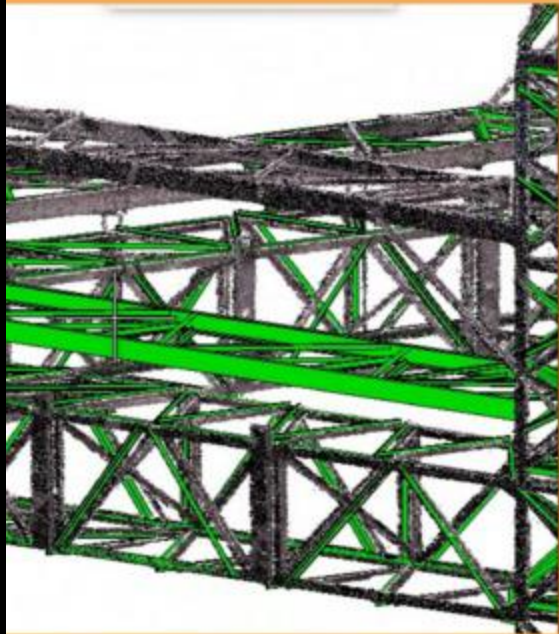


4' 11.6697"

7' 3.5937"



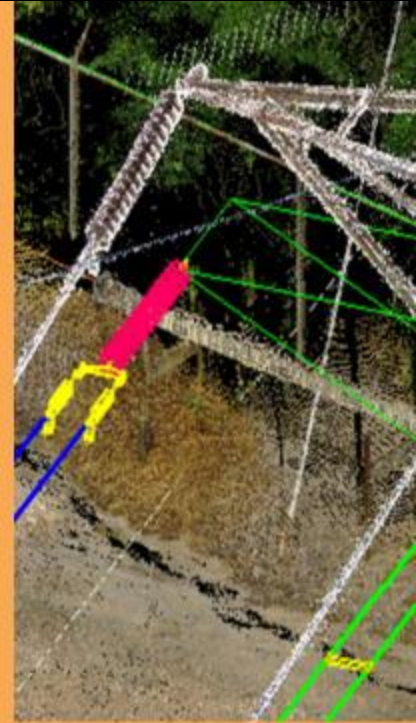






44945
SAM

AEP Lancaster
SUE 3D
17 Aug 2018 13:40

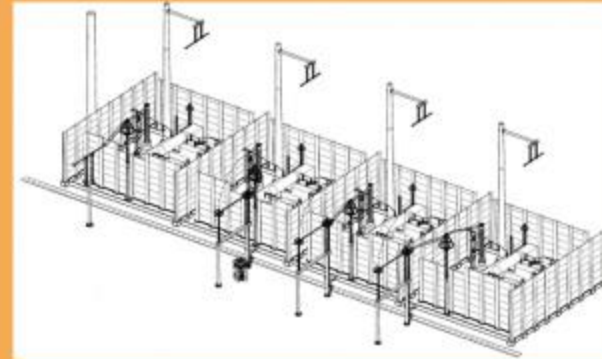


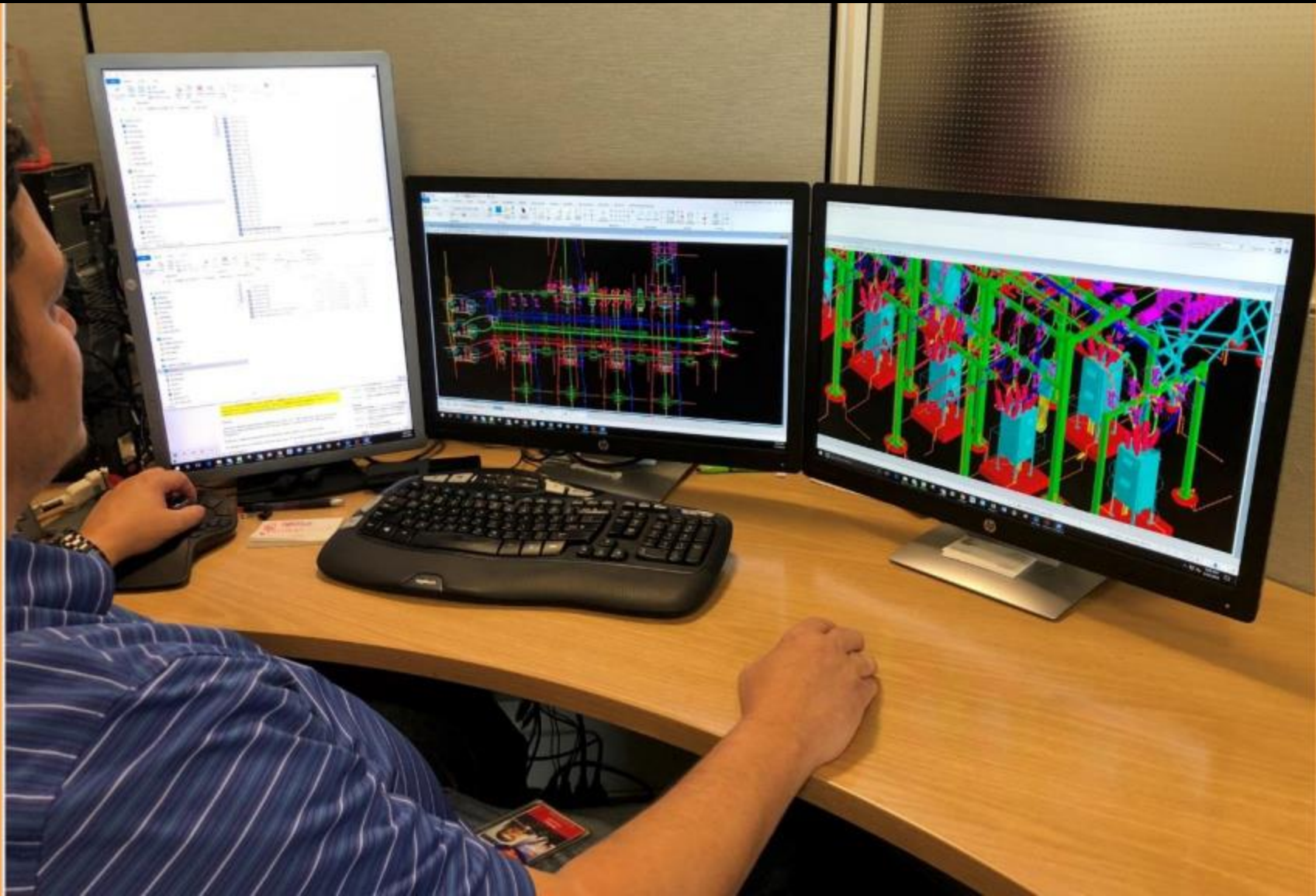
CONNECT IDEAS #2A

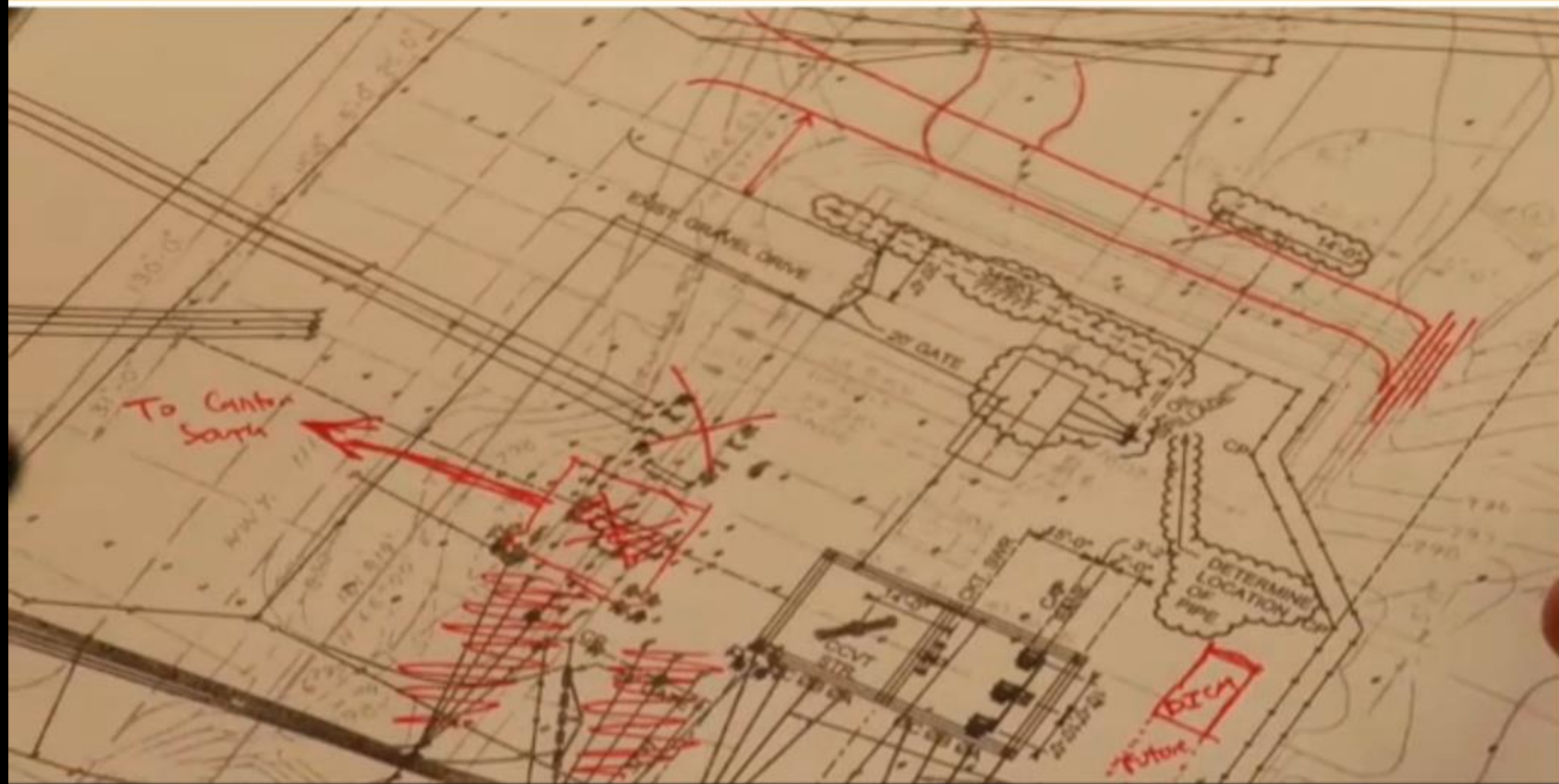
3D Model Used for
Engineering



Engineering Deliverable
is 2D Drawing Set





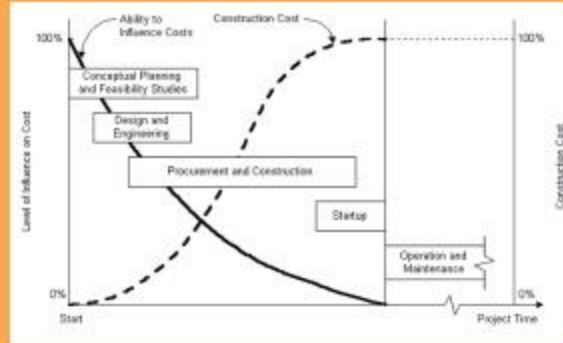


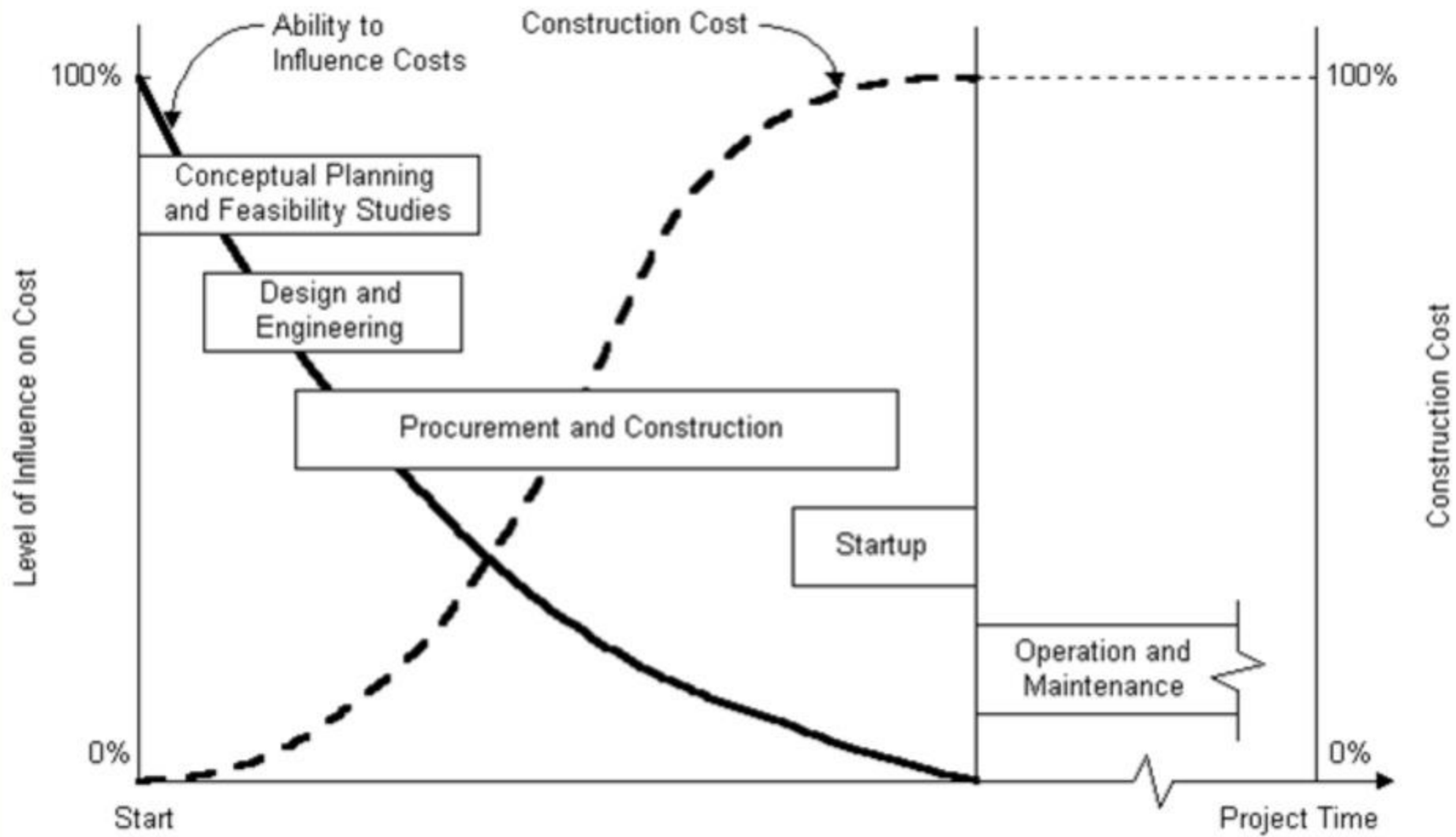
Make Connections #2A

Feasibility Studies &
Conceptual Scopes



More Effective
Project Planning







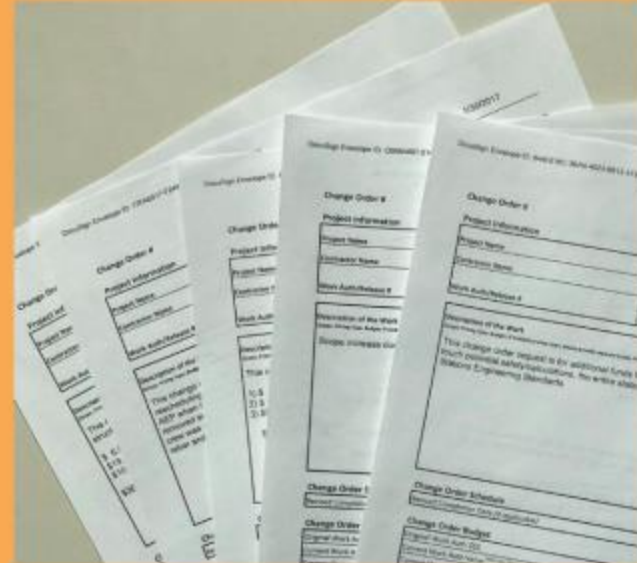


CONNECT IDEAS #2B

Complex Brownfield
Projects



Too Many
Change Orders

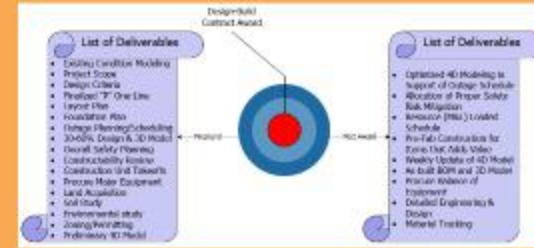
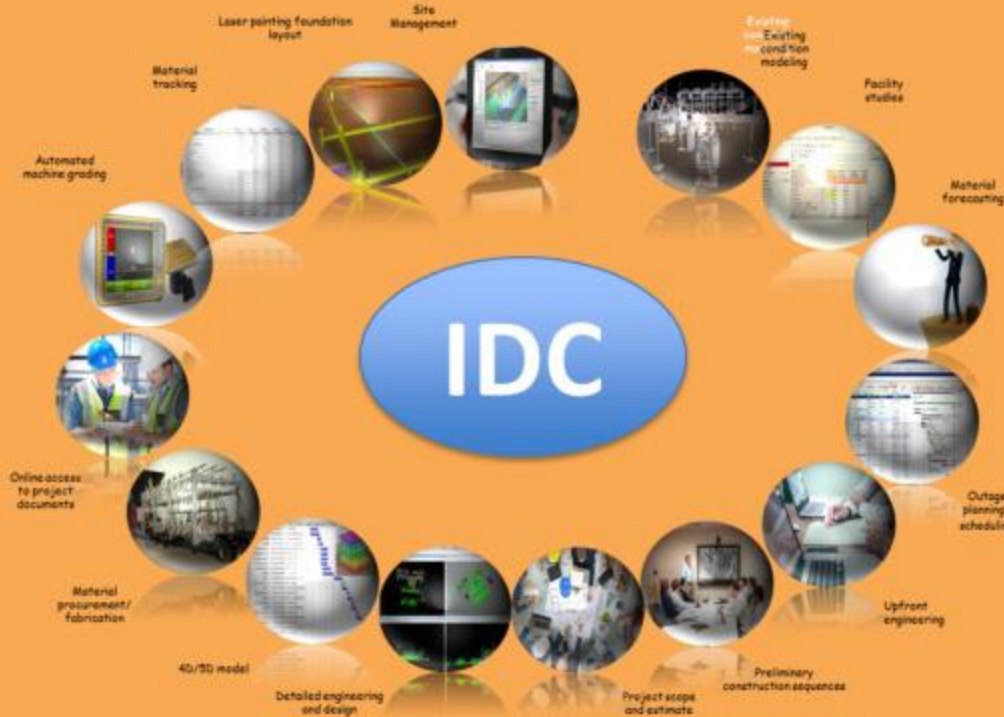


Make Connections #2B

Cost and Schedule
Certainty



Project Risk Mitigation By Improved
Project Planning and Execution

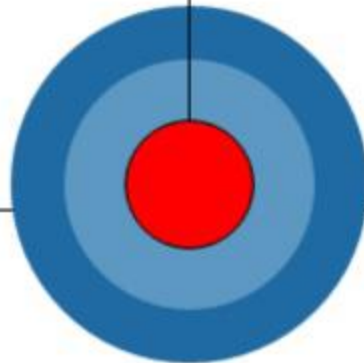


Design-Build
Contract Award

List of Deliverables

- Existing Condition Modeling
- Project Scope
- Design Criteria
- Finalized "P" One-Line
- Layout Plan
- Foundation Plan
- Outage Planning/Scheduling
- 30-60% Design& 3D Model
- Overall Safety Planning
- Constructability Review
- Construction Unit Takeoffs
- Procure Major Equipment
- Land Acquisition
- Soil Study
- Environmental study
- Zoning/Permitting
- Preliminary 4D Model

← Preaward

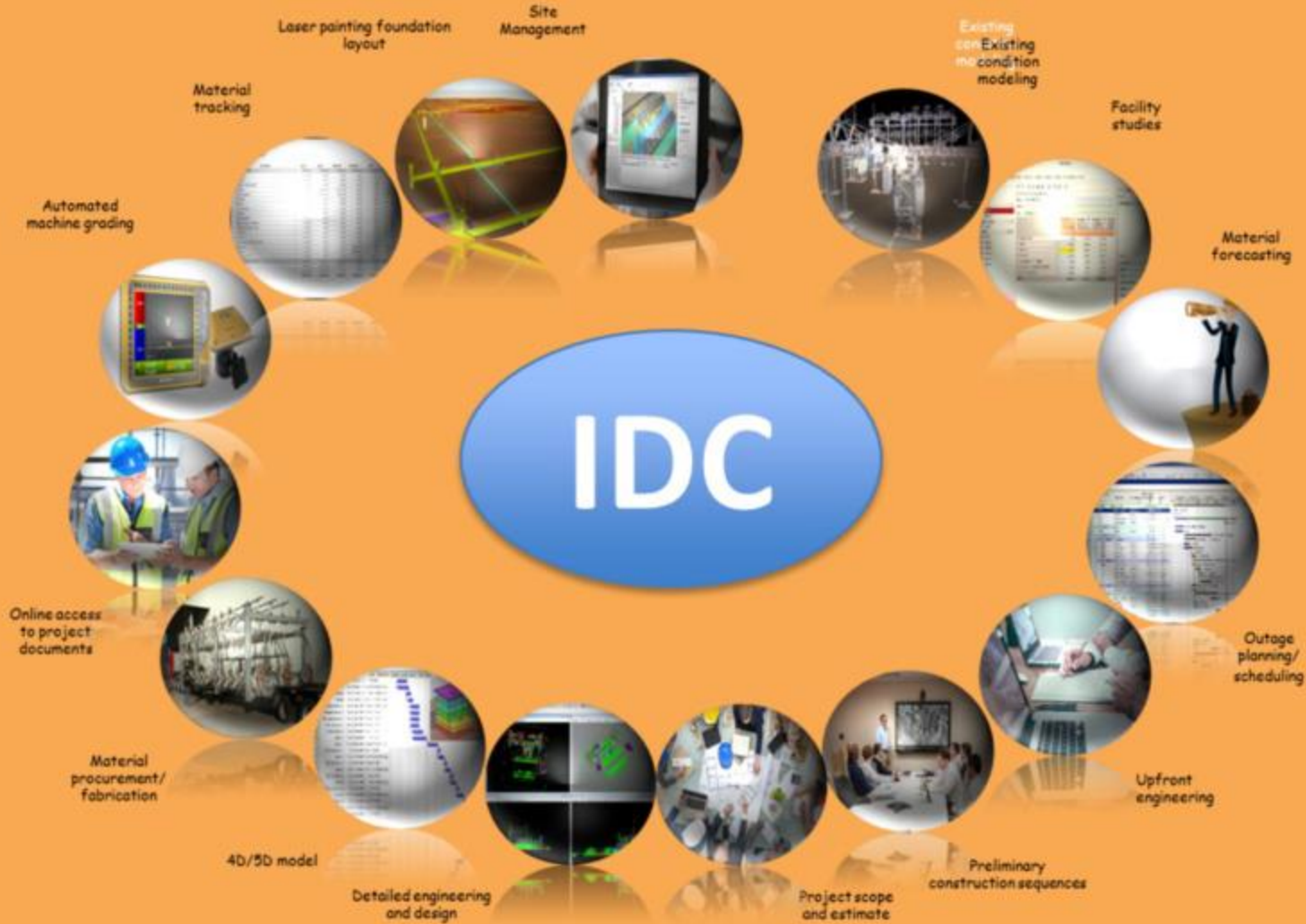


→ Post Award

List of Deliverables

- Optimized 4D Modeling in Support of Outage Schedule
- Allocation of Proper Safety Risk Mitigation
- Resource (M&L) Loaded Schedule
- Pre-Fab Construction for Items that Adds Value
- Weekly Update of 4D Model
- As-built BOM and 3D Model
- Procure Balance of Equipment
- Detailed Engineering & Design
- Material Tracking

IDC



List of Deliverables

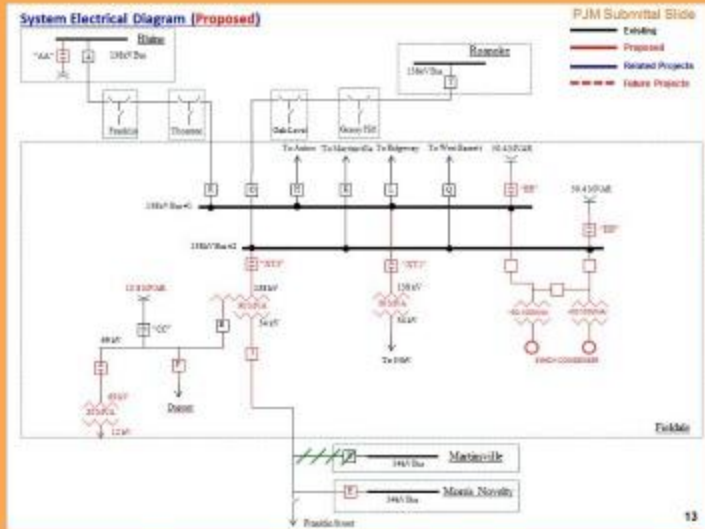
- Existing Condition Modeling
- Project Scope
- Design Criteria
- Finalized "P" One-Line
- Layout Plan
- Foundation Plan
- Outage Planning/Scheduling
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- Overall Safety Plan
- Constructability Review
- Construction Unit Takeoff
- Procure Major Equipment
- Land Acquisition
- Soil Study
- Environmental study
- Zoning/Permitting
- Preliminary 4D Model

CONNECT IDEAS #2C

Multiple Site Visits



Challenging Collaboration

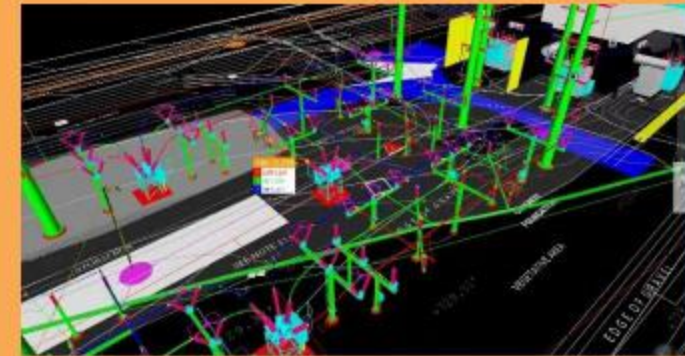
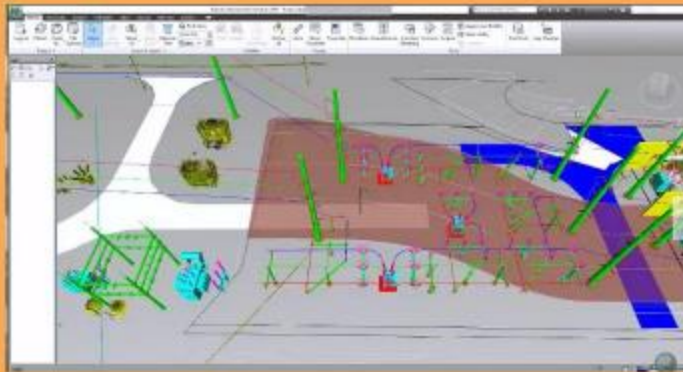
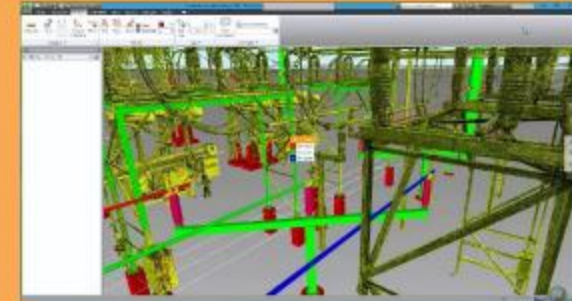
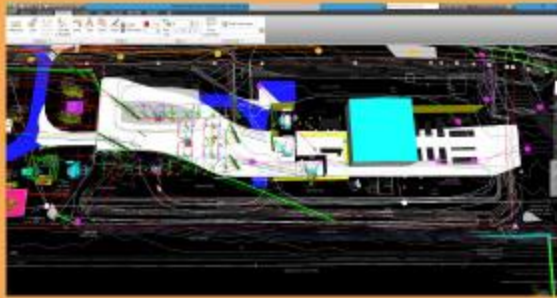


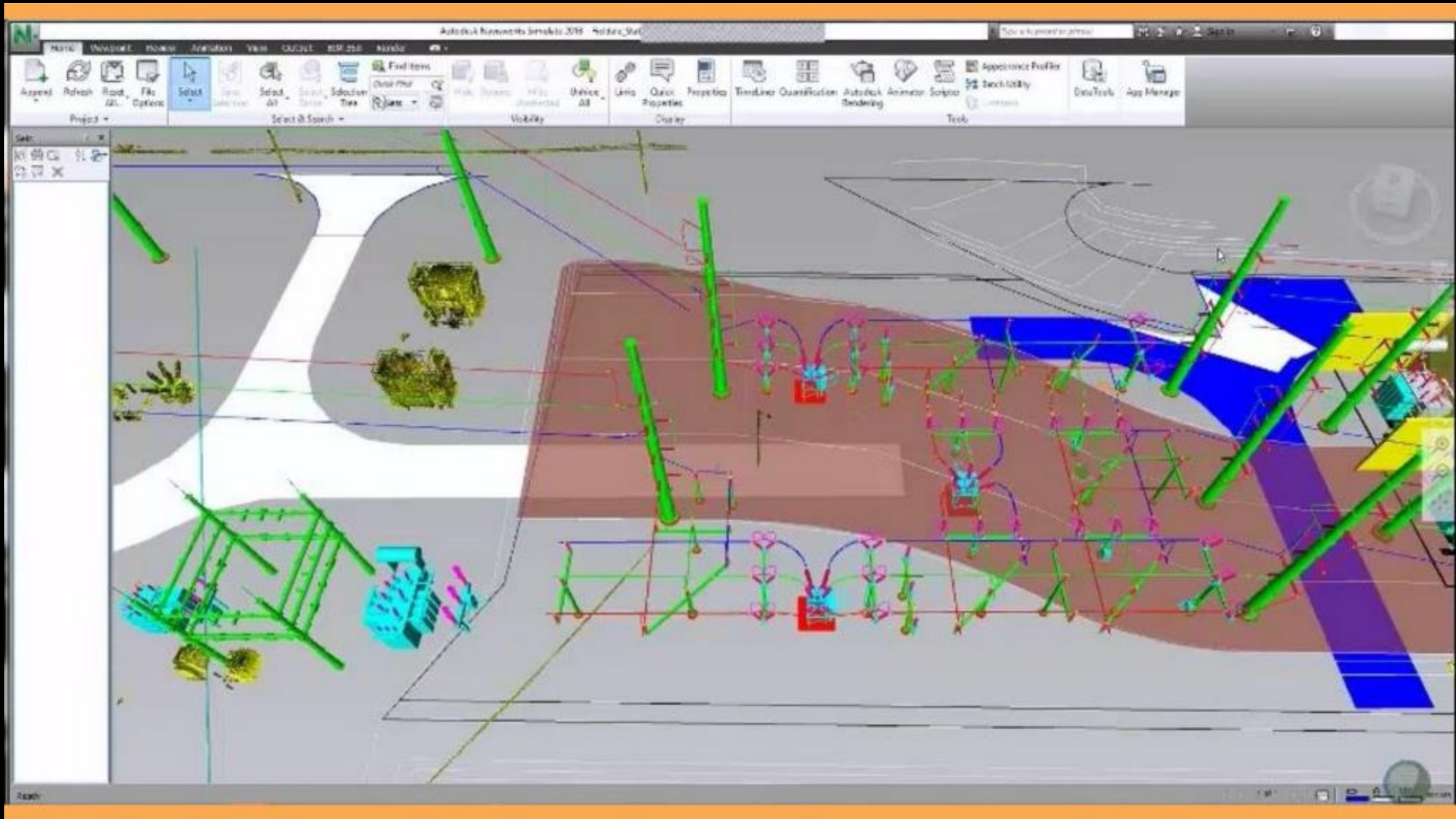
Make Connections #2C

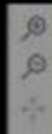
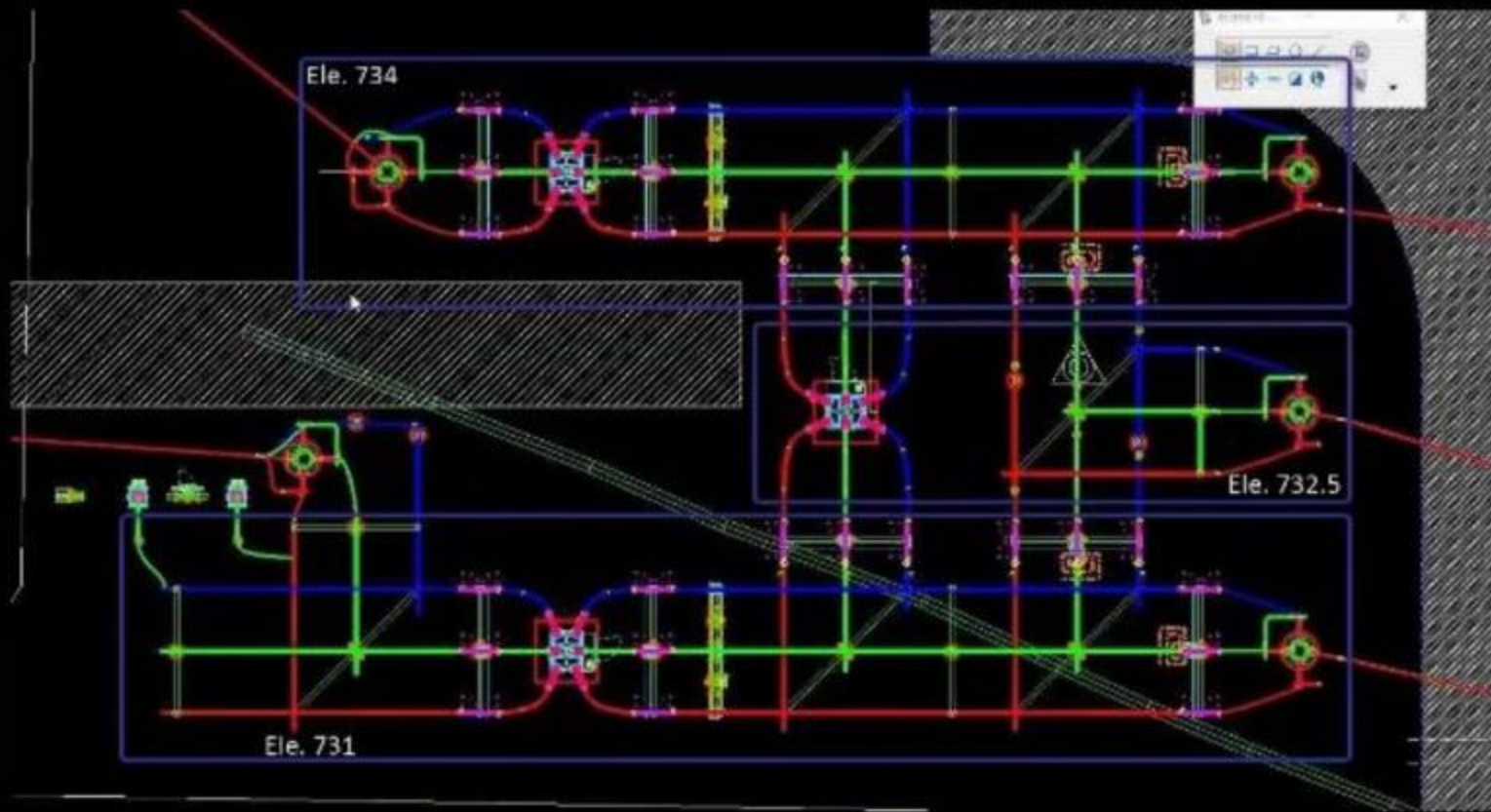
Virtual Design &
Construction

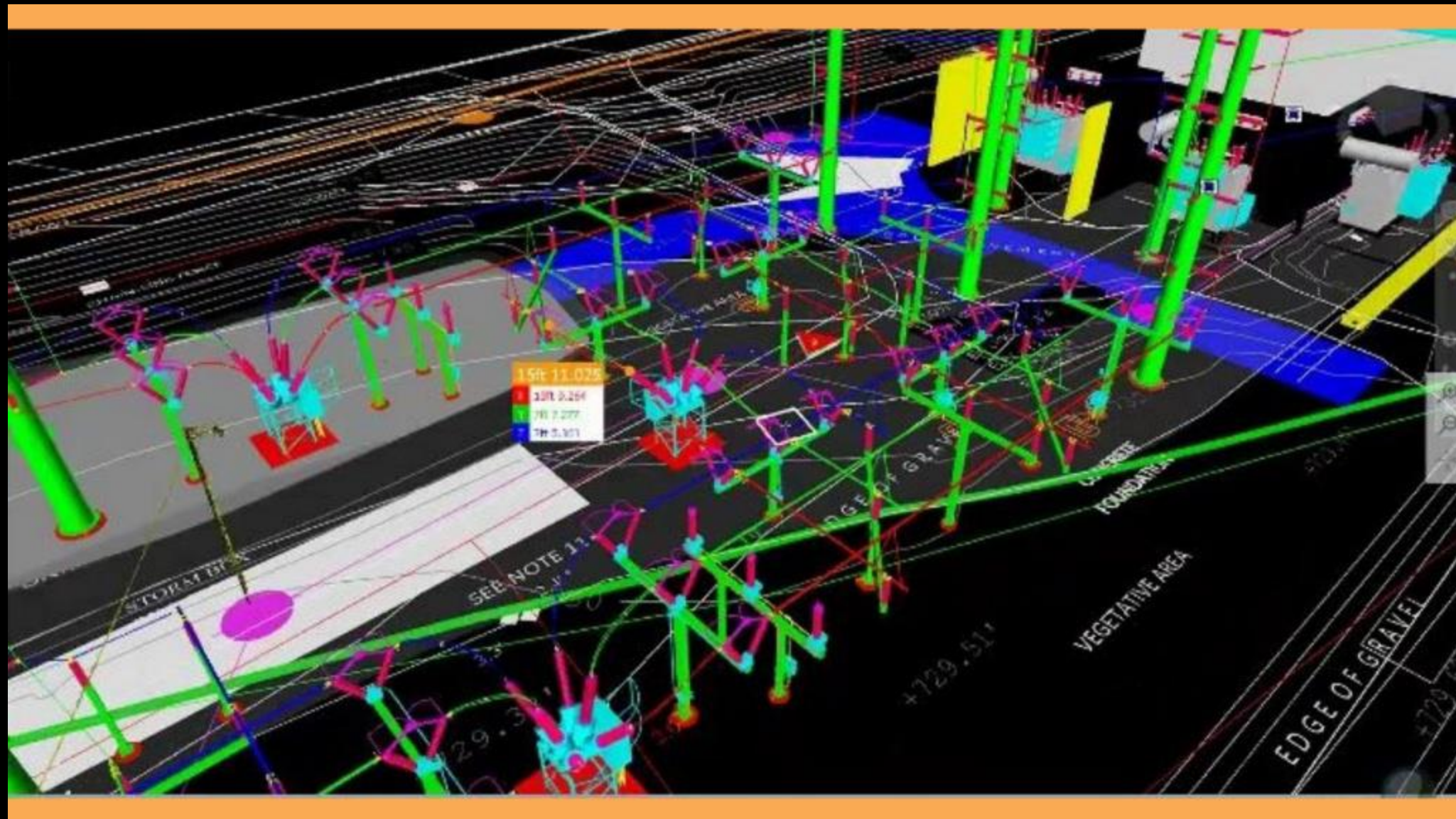


Faster & Higher Quality
Project Planning









CONNECT IDEAS #2D

Construction Contractors Lack
of Proficiency in Use of 3D/4D



Pilot Projects with Core
Construction Contractors

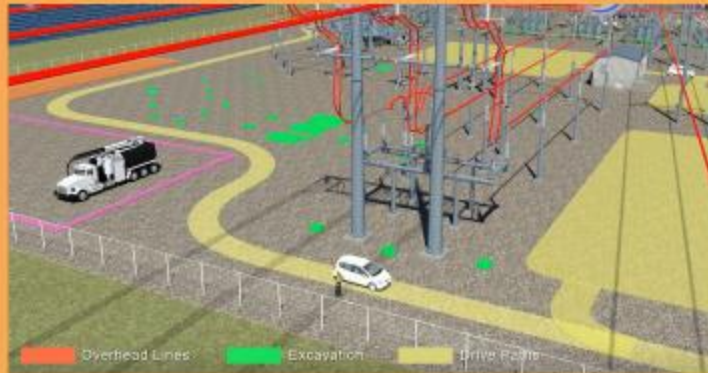
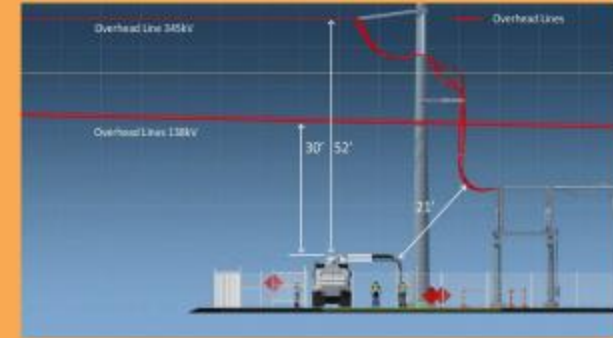
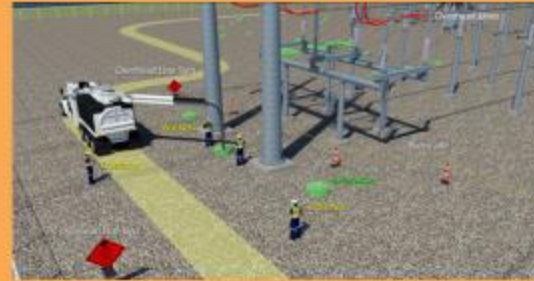
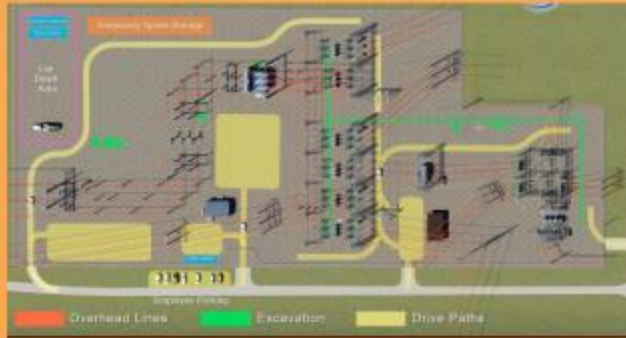


Make Connections #2D

Engage Contractors in Early
Stage of Project Development



Constructability Review &
Construction Sequences





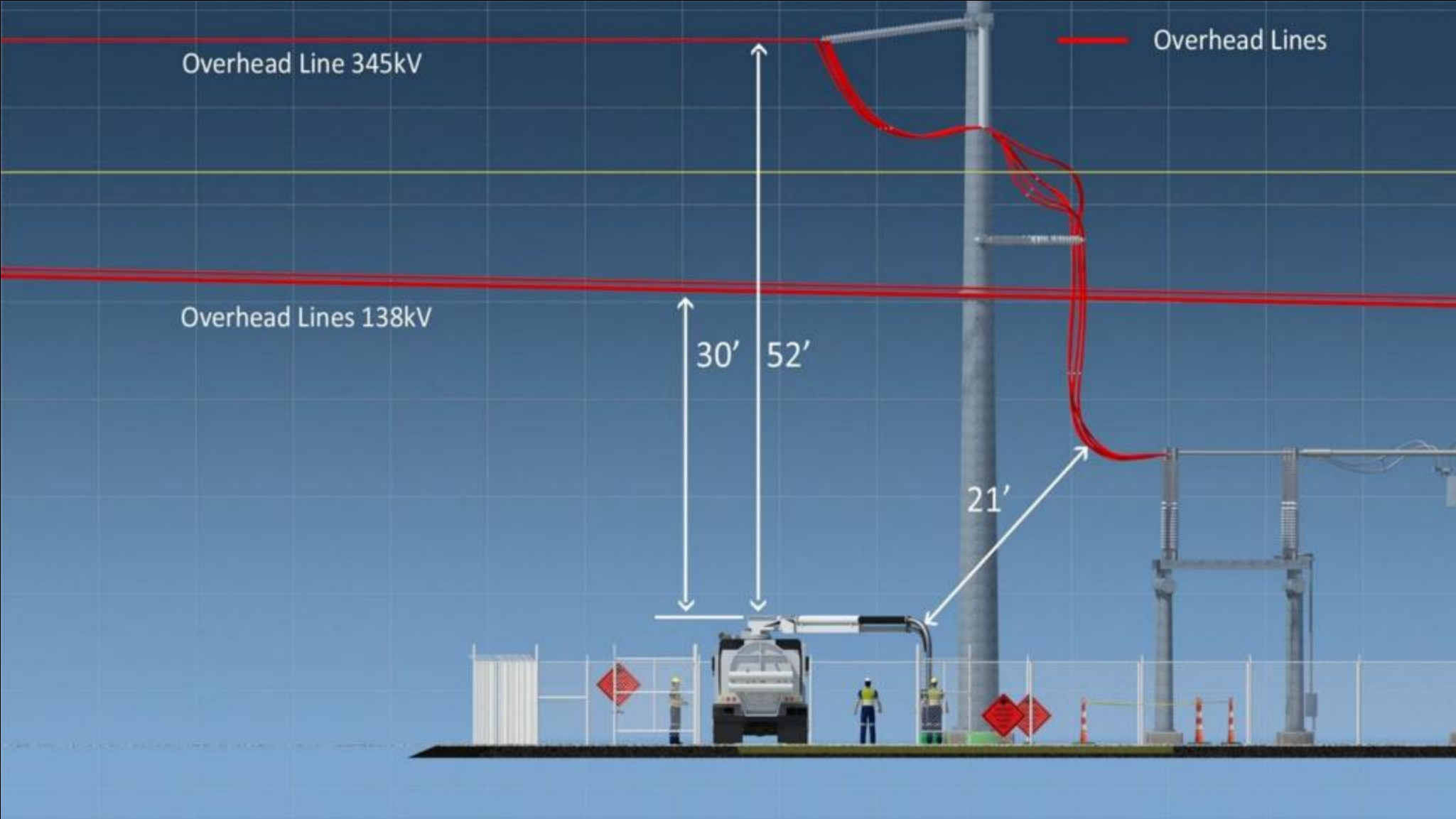
Overhead Line 345kV

Overhead Lines

Overhead Lines 138kV

30' 52'

21'





CONNECT IDEAS #2E

Inefficient As-Build
Process



Time Consuming Process
for Retrieving FMPs



Make Connections #2E

Construction Contractors to
Provide As-Built Model and BOM



Improved Alignment with On-site
Construction Changes

Thursday 4:07:44 PM 4/25/2019 Day=PM Week=30
Hard Lighting (62%)
Outside (100%)
New Data Source Room (99%)
Install Sub and Jumpers (Construct 94%)
Wade (94%)
0.

| Item | Name | Status | Planned Start | Planned End | Actual Start | Actual End | Ad | Monday, April 22, 2019 | Tuesday, April 23, 2019 | Wednesday, April 24, 2019 | Thursday, April 25, 2019 | Friday, April 26, 2019 | Saturday, April 27, 2019 | Sunday, April 28, 2019 |
|--------|---|--------|---------------|-------------|--------------|------------|---------|------------------------|-------------------------|---------------------------|--------------------------|------------------------|--------------------------|------------------------|
| 10.00% | Hard Lighting (62%) | 100% | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00% | Outside (100%) | 100% | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14.00% | New Data Source Room (99%) | 99% | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14.00% | Install Sub and Jumpers (Construct 94%) | 94% | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.00% | Wade (94%) | 94% | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4/22/19 | 4.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

CONNECT IDEAS #2F

Construction Progress
Reporting & Inspection



UAS for Change Detection
and Identification



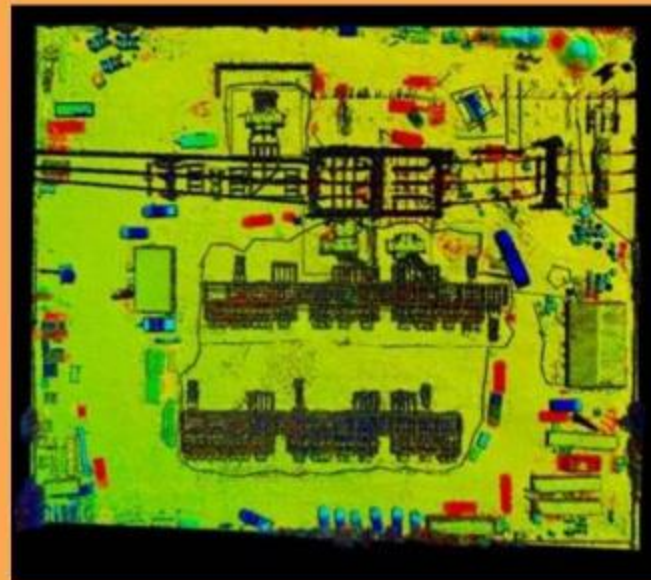
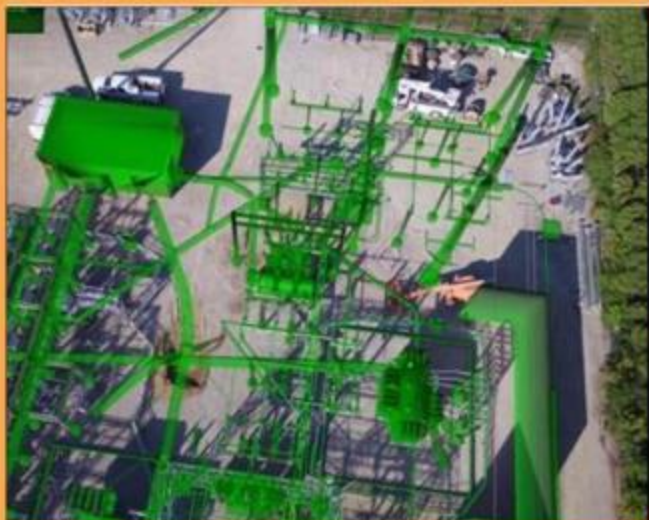


Make Connections #2F

Automating Construction
Site Monitoring



Cash Flow Projection,
Earned Value, As-Builds





CONNECT IDEAS #3

Material Issued
for Project



Manual Process for
Creating BOM

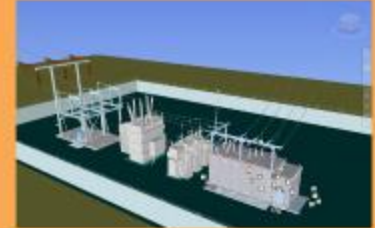
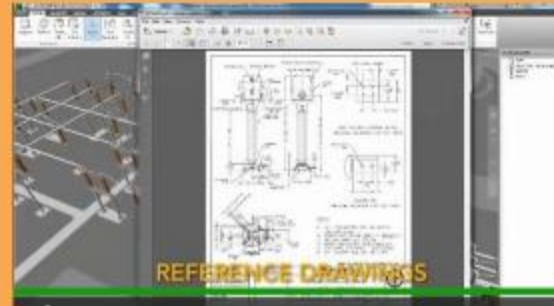


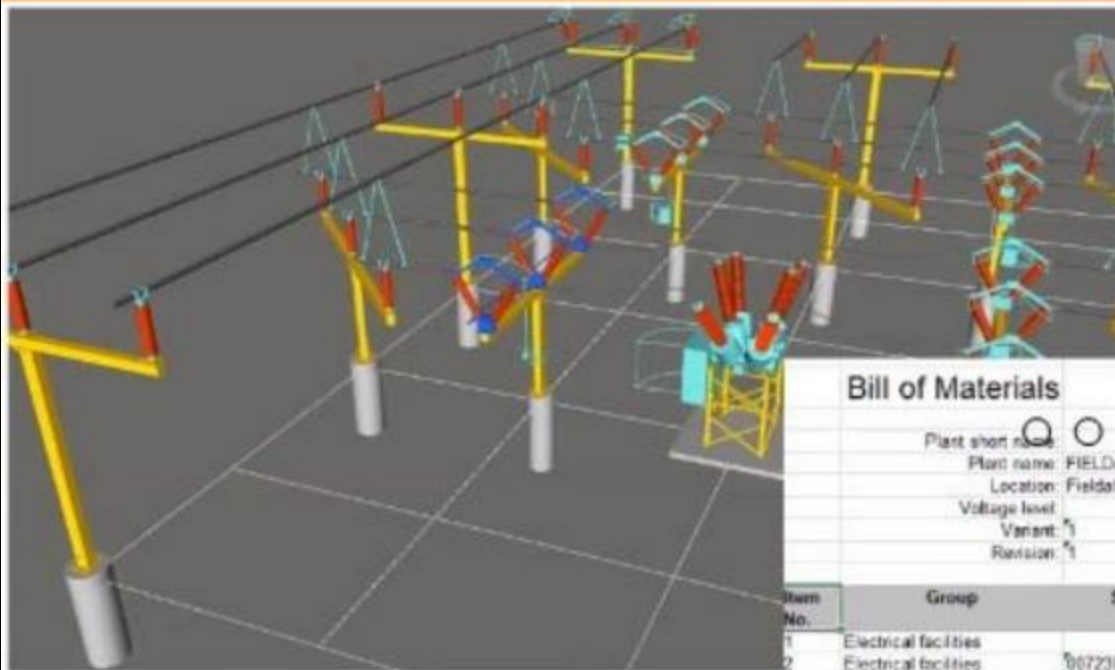
Make Connections #3

Material Issued
for Each Outage



BOM Automatically
Generated From Model



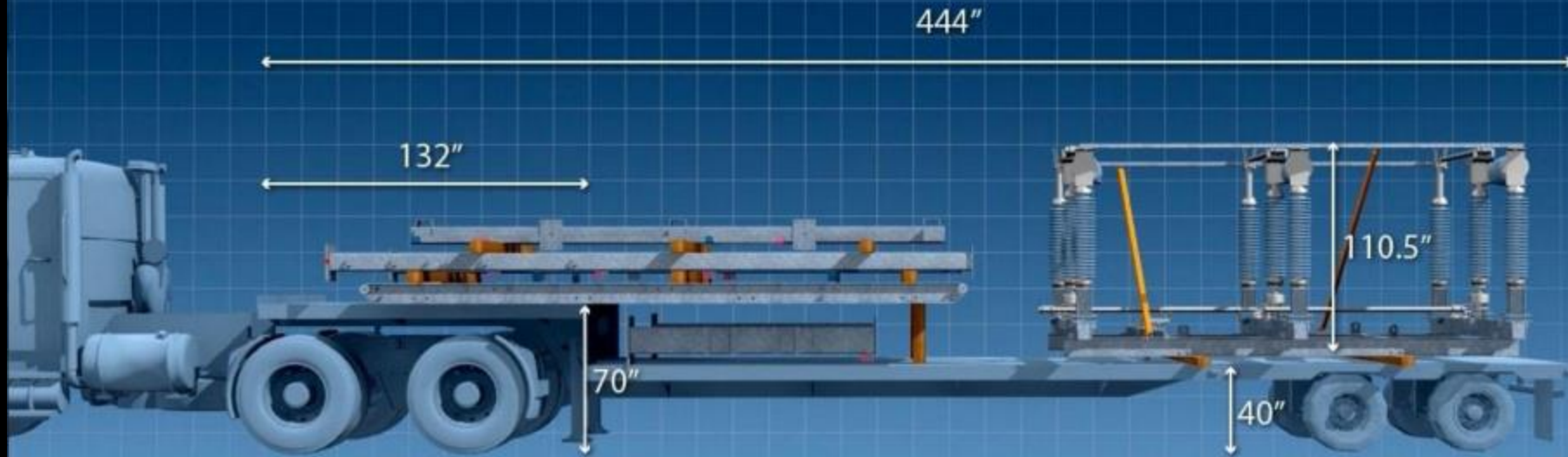


Bill of Materials

Plant short name:
 Plant name: FIELDALE STATION
 Location: Fieldale / Henry, VA, USA
 Voltage level:
 Variant:
 Revision:

| Item No. | Group | Short name | Long name | Quantity | Unit |
|----------|---------------------------|------------|---|----------|------|
| 1 | Electrical facilities | | Motor Operator, 120VAC, 6 B SEC | 4.00 | Pcs |
| 2 | Electrical facilities | 0072386121 | 138kV Center Break Switch, 100KA MOM | 6.00 | Pcs |
| 3 | Electrical facilities | 0500000054 | 138kV SP6 Dead Tank Circuit Breaker, 40KA IC | 1.00 | Pcs |
| 4 | Foundations | | 138kV Circuit Breaker Foundation | 1.00 | Pcs |
| 5 | Foundations | | Concrete | 38.40 | yd³ |
| 6 | Foundations | | Excavation | 34.14 | yd³ |
| 7 | Foundations | | Reinforcement steel | 8447.36 | lb |
| 8 | Foundations | P3008 | 138kV V-SW Foundation 10' H BUS (8.00 ft) | 6.00 | Pcs |
| 9 | Foundations | P36DC | 138kV V-SW & Bus Support Foundation 22' H BUS (8.00 ft) | 10.00 | Pcs |
| 10 | Insulators | 0048769500 | 138kV Station Post Insulator, 550kV DL (3.75 ft) | 30.00 | Pcs |
| 11 | Steel-grdtr constructions | 0074383400 | V-Switch structure, 138kV, 550kV DL, 3 PH 15FT BUS Height, 10 FT Spacing | 4.00 | Pcs |
| 12 | Steel-grdtr constructions | 0500076991 | V-Switch structure, 138kV, 550kV DL, 3 PH 22FT BUS Height, 10 FT Spacing | 2.00 | Pcs |
| 13 | Steel-grdtr constructions | 0500076994 | Bus Support structure, 138kV, 550kV DL, 3 PH 22FT BUS Height, 10 FT Spacing | 6.00 | Pcs |
| 14 | Steel-grdtr constructions | 0500076997 | Bus Support Structure, 138kV, 550kV DL, 3 PH 15FT BUS Height, 10 FT Spacing | 6.00 | Pcs |

HV SKID - SHIPPING ARRANGEMENT OPTION 1



TOTAL WEIGHT
21,420 LBS

Mobile_Substation_Rev02



CONNECT IDEAS #4

Construction
Schedule at Risk



Lack of Resources &
Weather Conditions







Make Connections #4

Apply PreFab
Construction Method



Fast-Tracking
Construction











Present Your Plan

Developing a balanced approach to IDC is based on the continuous improvement triangle: technology, process, and people. It is essential to ensure that all three components are aligned for successful implementation of IDC.

Step #1

Pilot IDC Projects With
Select Contractors

Step #2

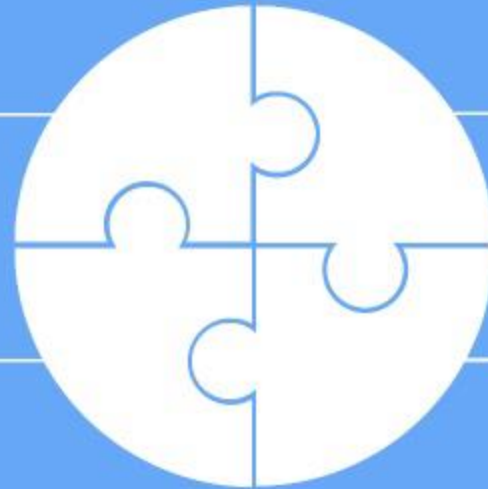
Implement New
Software & Hardware

Step #3

Revise Standards &
Workflows

Step #4

Selective Implementation
Followed by Full Scale
Roll-out





Masoud Rafiee, P.E., PMP

