“Engineering-Scale Demonstration of Transformational Solvent on NGCC Flue Gas” (Project Enterprise)

DE-FE0031950

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Project Manager: Jennifer Atcheson

U.S. Department of Energy
National Energy Technology Laboratory
Carbon Management and Natural Gas & Oil Research Project Review Meeting
Virtual Meetings August 2 through August 31, 2021

Outline

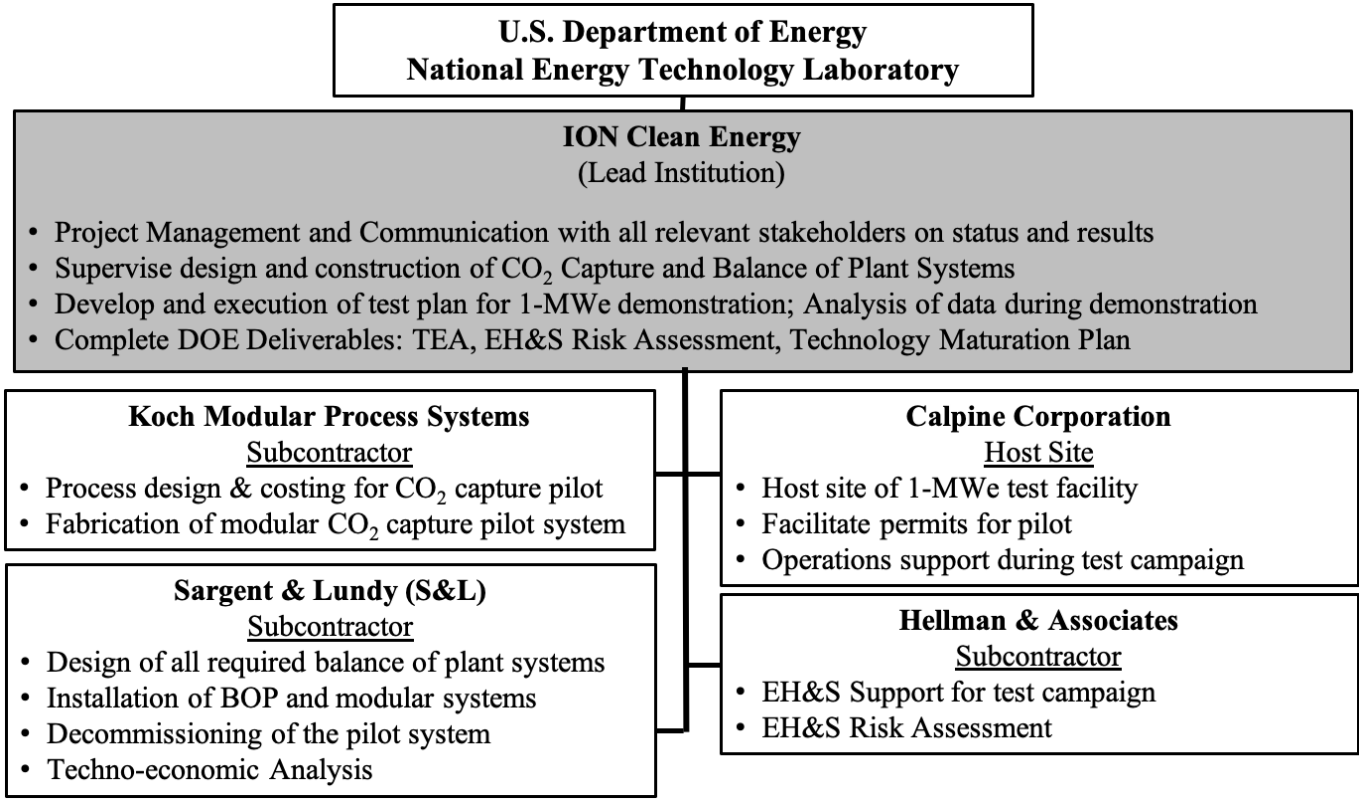
- Project Overview
- Introduction to Technology
  - Results from NCCC Pilot
- Project Scope and Schedule
- Progress & Current Status
  - Design Basis
  - Balance of Plant Design
  - Module and GA Drawings
- Summary & Development Path

DE-FE0031950: Project Enterprise

- Overall Project Objective:
  - To field test an engineering scale 10 tonnes per day (tpd) CO_2 capture system on a 1 megawatt-electric (MWe) slipstream flue gas from a commercially dispatched natural gas combined cycle (NGCC) power plant to empirically validate the low capital and operating costs for ICE-31
- Budget:
  - DOE-NETL: $13,000,000
  - ION and partners: $3,906,839
- Period of Performance:
  - October 1, 2020 to October 31, 2023

Calpine's Los Medanos Energy Center (LMEC)
Pittsburgh, CA

Project Enterprise Team

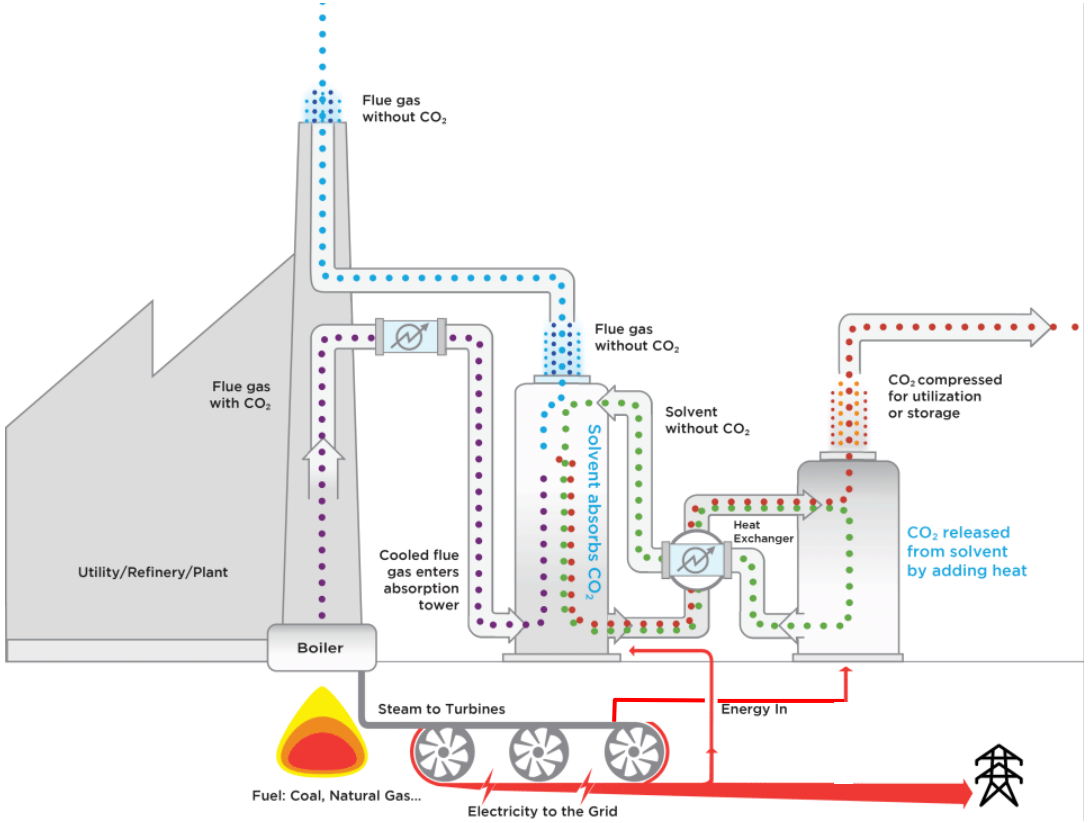


ICE-31 SOLVENT TECHNOLOGY

ICE-31

Basis of Performance
(compared to ICE-21)

- Lower energy consumption
- Similar fast kinetics
- Higher working capacity
- Low heat capacity
- Low corrosion
- Revolutionary stability



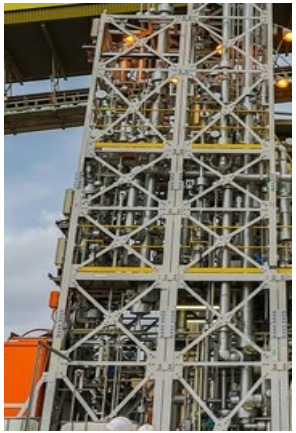
ION's CO_2 Capture Technology Development – ICE-31

Development Path

2016

Lab Development

Simulated Flue Gas



2017 - 2018

Bench-scale Pilot

Coal

2020 - 2021

National Carbon Capture Center

0.5 MWe

Coal & Natural Gas

2020 - 2023

Project Enterprise Engineering Scale

10 tpd (~1 MWe)

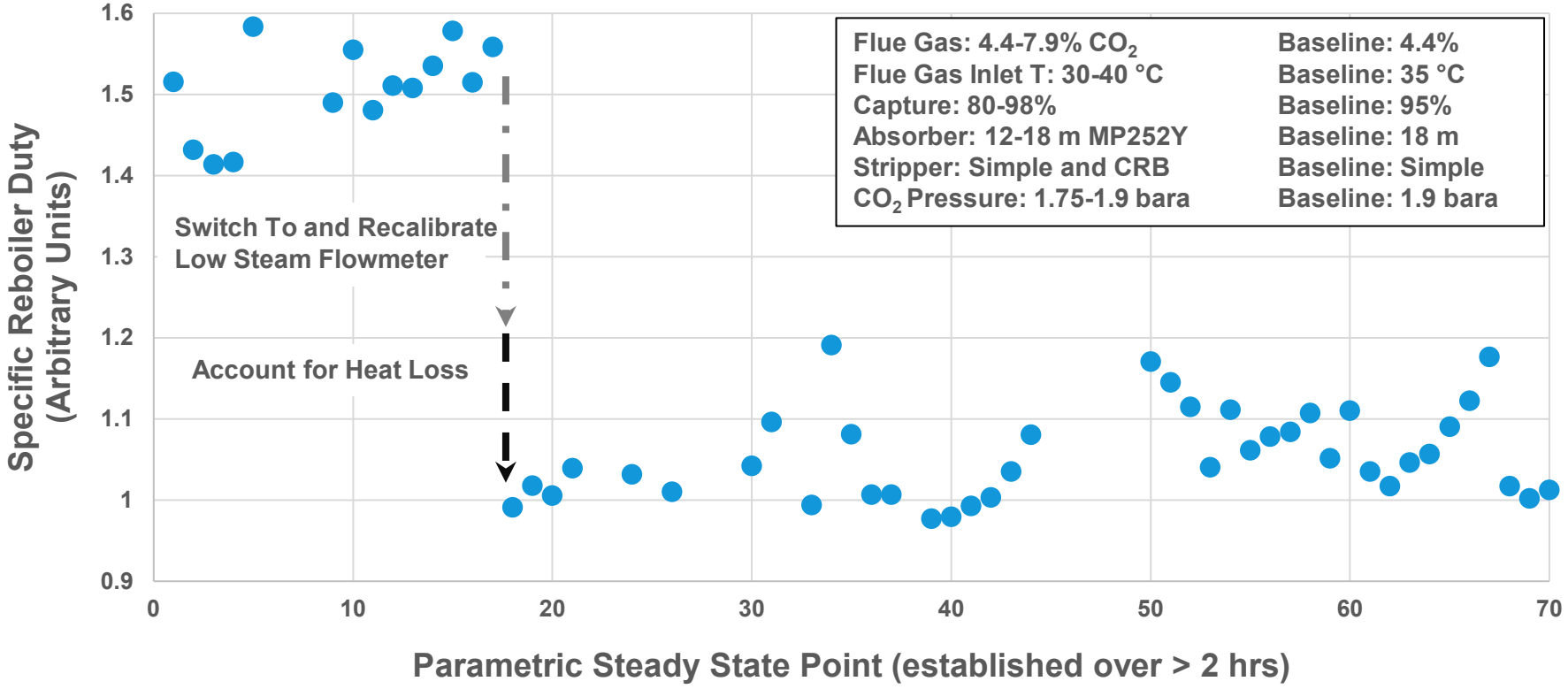
Natural Gas

2022 →

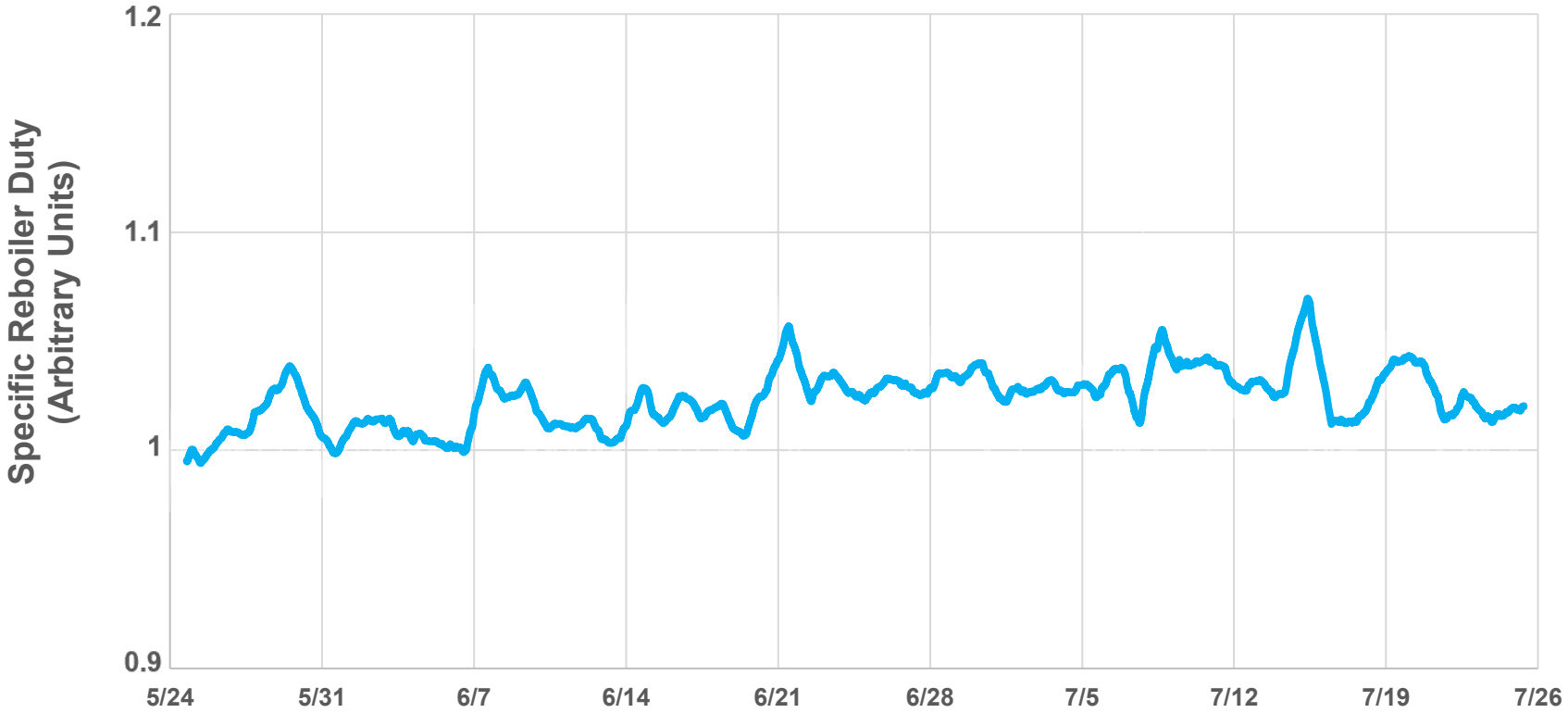
Commercial Scale

First 60 Days of Operation

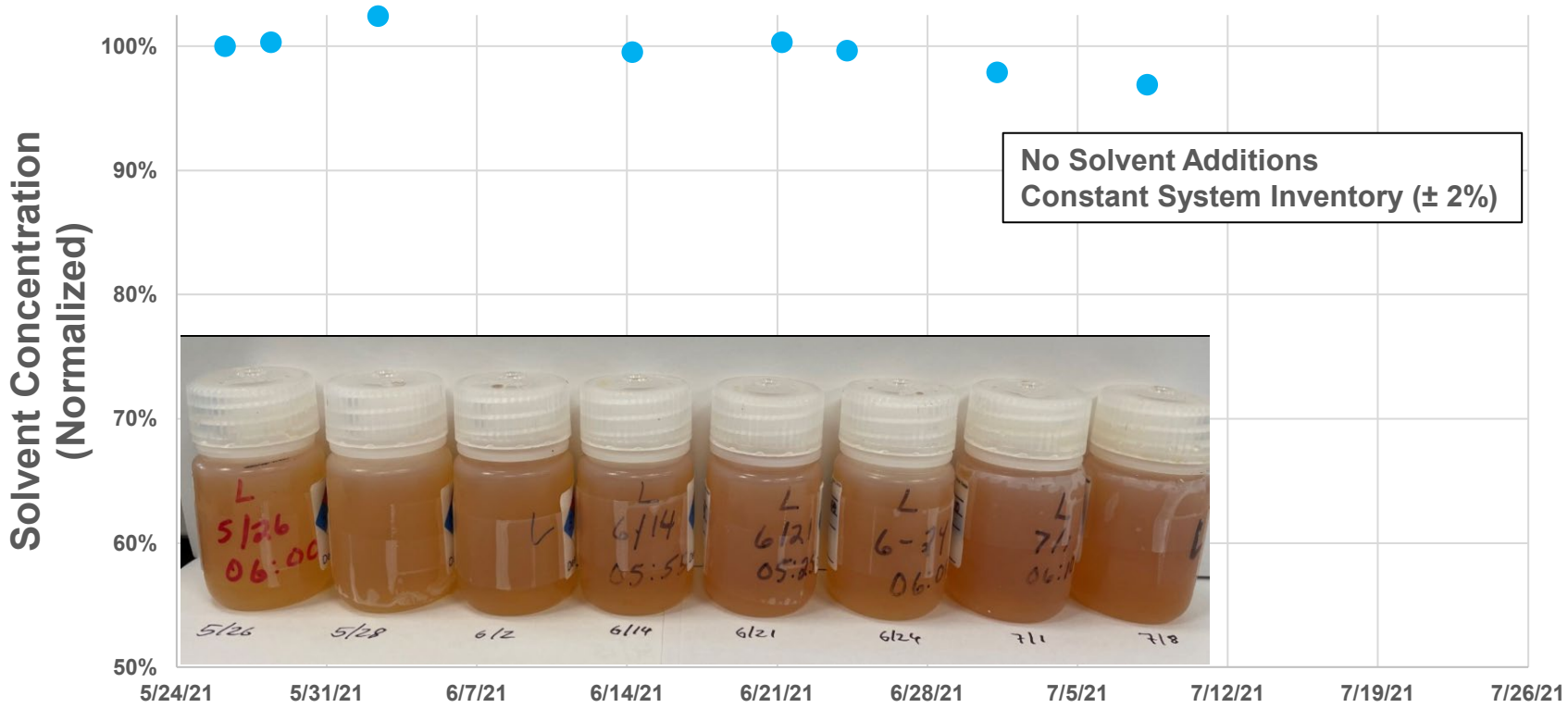
70 Different Parametric Settings



Stable SRD and Operations



NCCC Apollo Campaign



PROJECT SCOPE AND SCHEDULE

Project Scope and Key Milestones

- Design, permit, and cost permit the pilot plant
- Finalize engineering, fabricate modules, and develop controls
- Install modules, connect Balance of Plant, finish commissioning
- Field-test ICE-21 and ICE-31 with NGCC flue gas
- Final data evaluation and extensive reporting

#	Milestone Title / Description	Planned Completion Date	Actual Completion Date
M2	Kickoff Meeting	12/04/2020	12/09/2020
M4	HAZOP Completed	3/10/2021	05/27/2021
M6	Modular Pilot System Cost	3/24/2021	06/18/21
M8	Balance of Plant Cost	5/18/2021	06/18/21
M12	Modular System Factory Acceptant Testing	2/28/2022	
M14	Complete Pilot System Site Acceptance Testing	5/24/2022	
M16	Baseline MEA and ICE21 Testing	09/21/2022	
M17	ICE31 Testing	10/05/2023	
M19	DOE Close-Out Meeting	12/31/2023	

Success Criteria

Decision Point	Success Criteria
Conclusion of BP1	• Completion of initial TEA and EH&S Risk Assessments • Completion of design package for modular pilot system • Fixed price quotation for modular pilot system • Completion of design of BOP scope to commence construction period • Approval from the host site to commence construction period
Conclusion of BP2	• Fabrication, delivery, installation and commissioning of modular pilot system and all balance of plant tie-ins • Test plan finalized • Solvents required for test campaign delivered to host site
Project Completion	• Completion of engineering-scale demonstration of baselines and ICE-31 • Issuance of updated TEA and EH&S Risk Assessments

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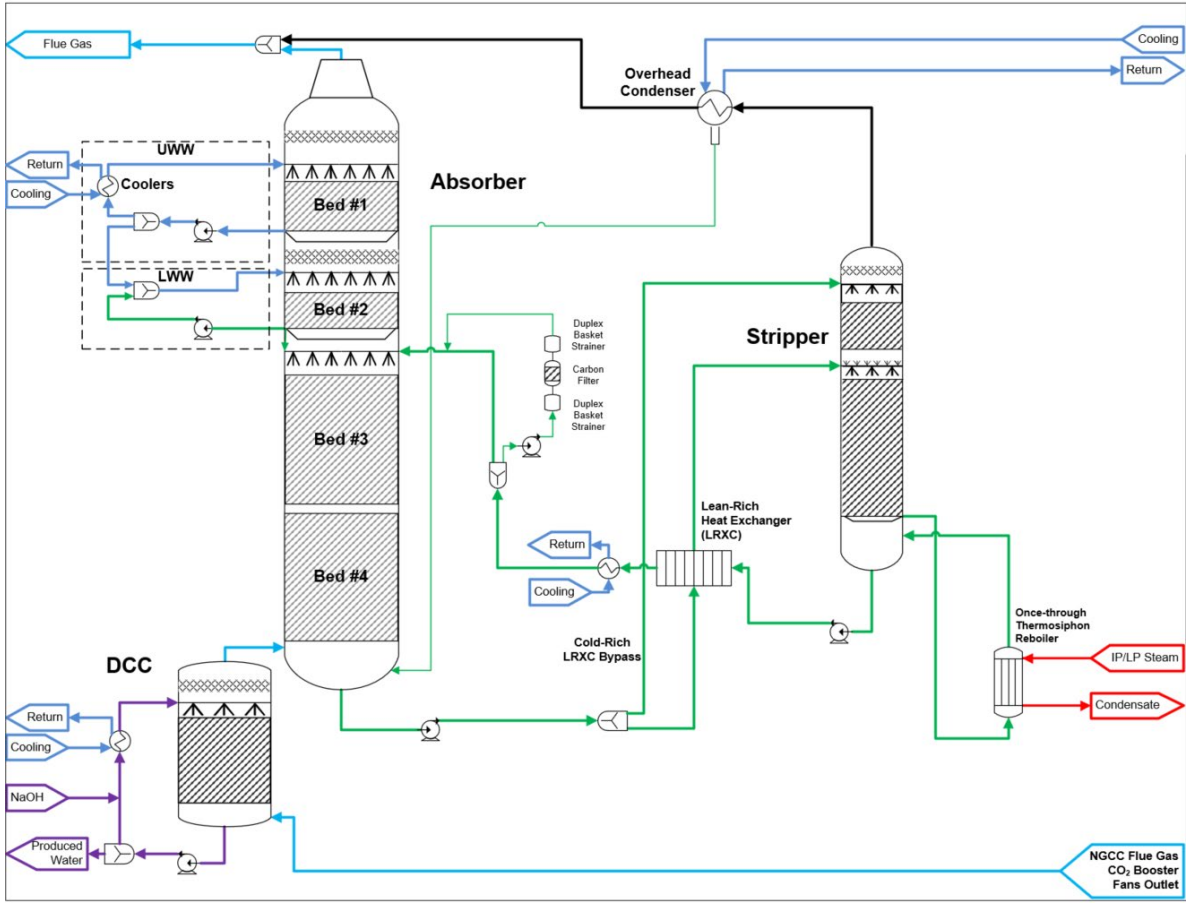
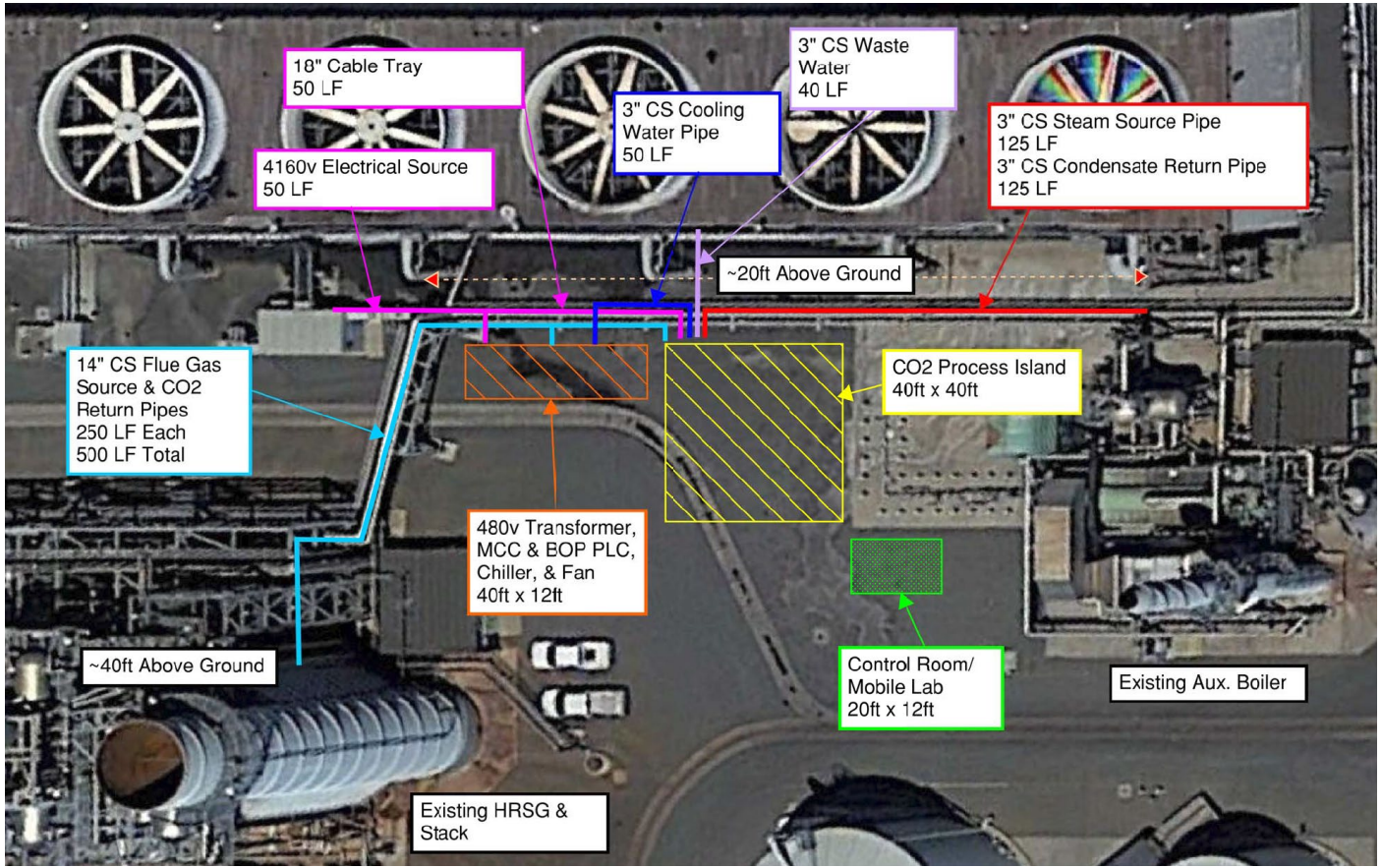
CURRENT PROGRESS

Design Basis

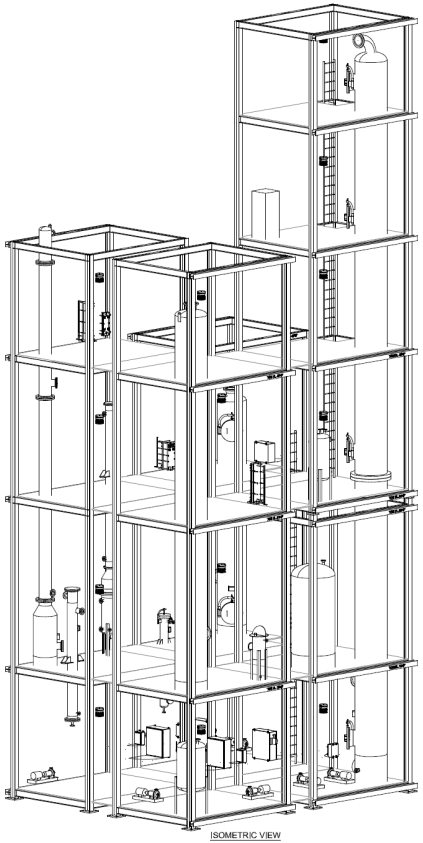
PFD

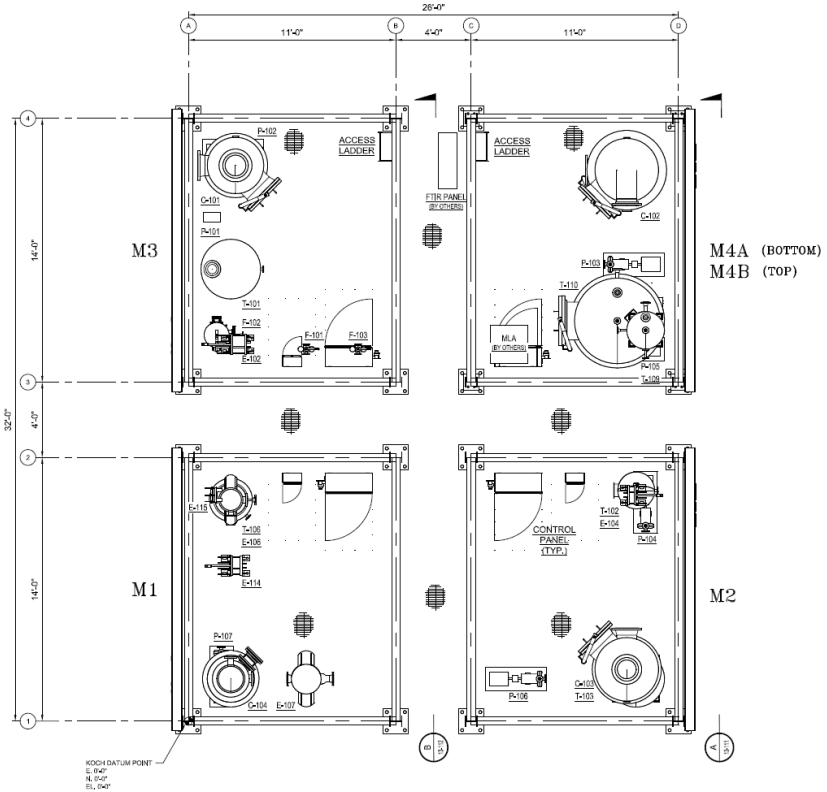


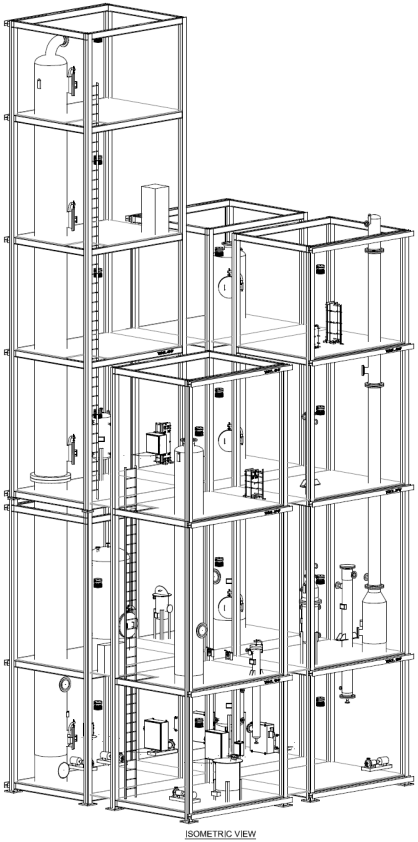
Site Plan



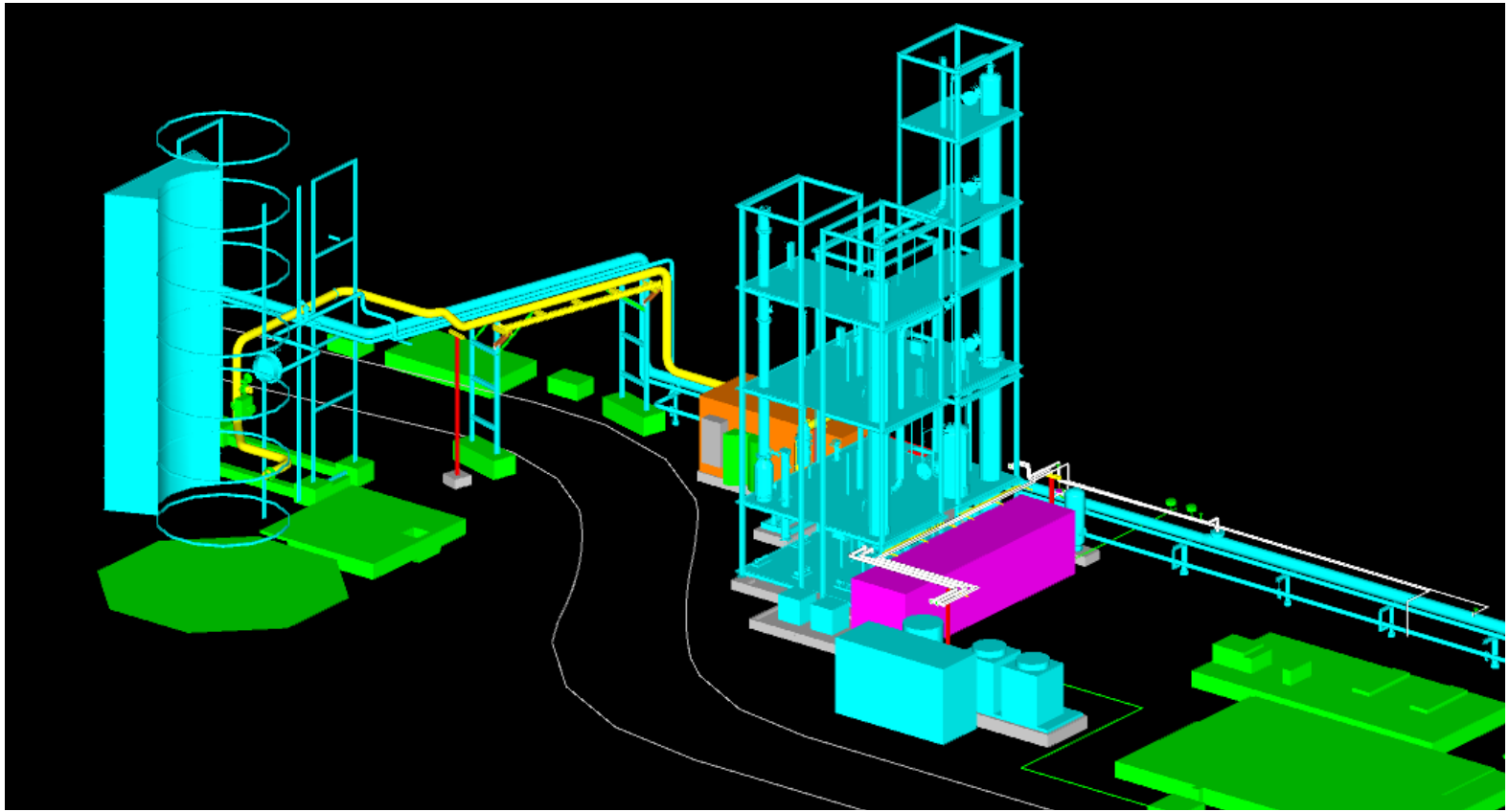
Modular Design







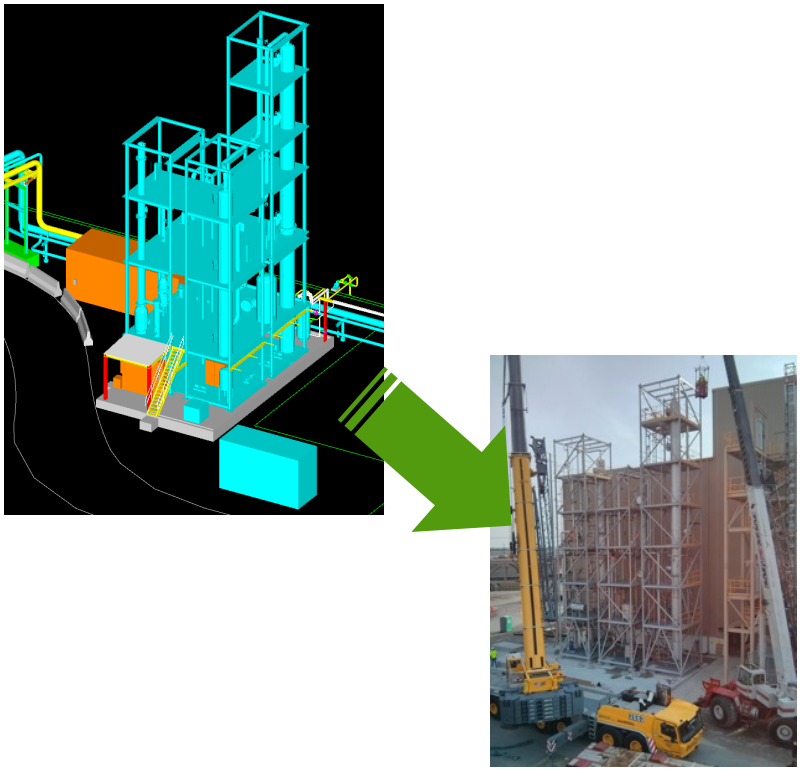
Modular Design



SUMMARY AND DEVELOPMENT PATH

Current Project Findings & Next Steps

- Completed Engineering Phase of BP1
  - Final design is very similar to initial conceptual design
- HAZOP completed in coordination with host site
- Modular system design is prior Koch Modular built units
- No “showstoppers” in permitting
  - California permitting is among most stringent in the US
  - ION’s solvent and process mitigate hazardous emissions
- Continuation application submitted



*Example of Typical Koch Modular Install

Project Enterprise Next Steps

Budget Period 1
4Q2020 – 2Q2021

- Host Site Agreement
- Modular System Design
- BOP Design
- Cost Estimates for Construction
- Permitting

Budget Period 2
Starts 3Q2021

- Modular System Fabrication
- Site Preparation
- Installation
- Commissioning

Budget Period 3
2022 – 2024

- Baseline Testing MEA & ICE-21
- ICE-31 Testing
  - ➢Parametric
  - ➢Long-term Testing
- Final Reporting

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THANKS

Acknowledgement

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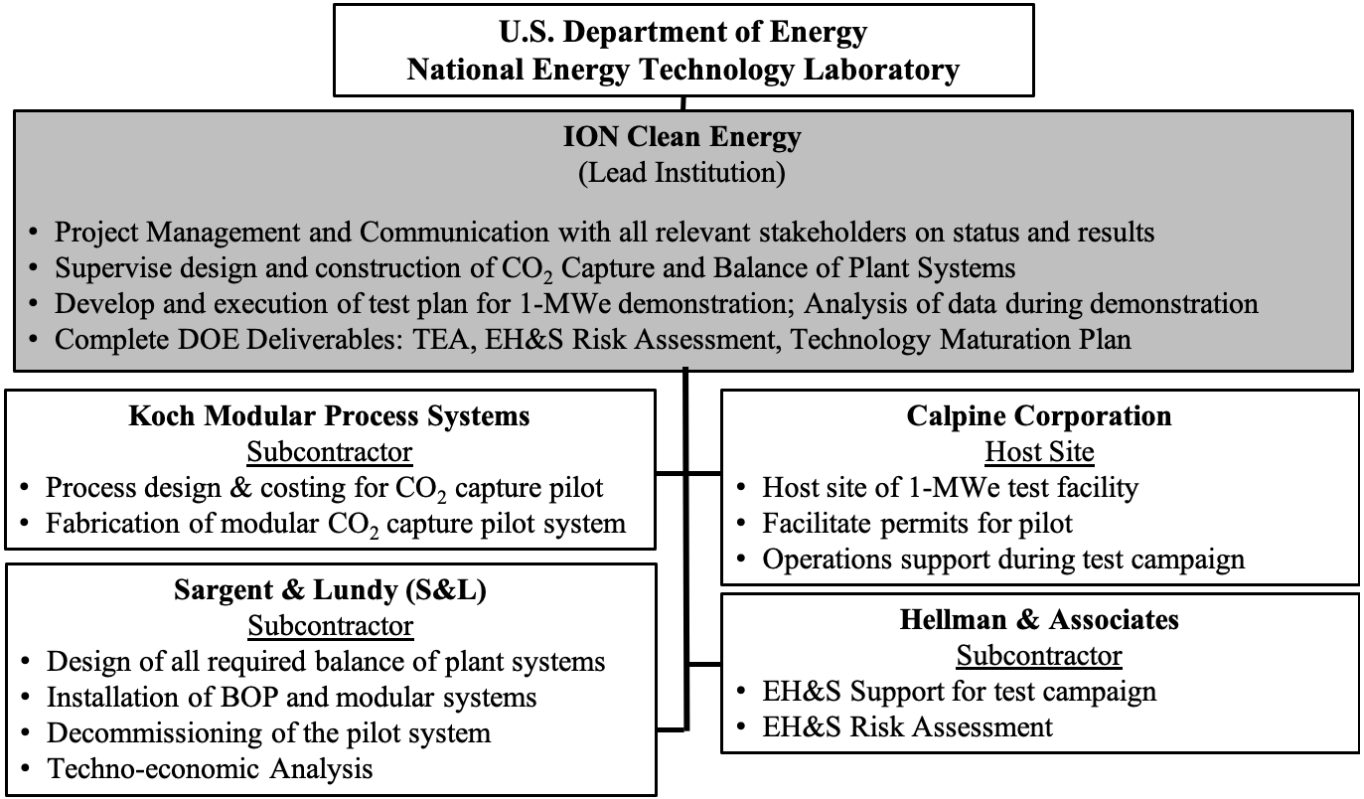
Project Enterprise Team



Project Schedule

ID	% Complete	Task Name	Duration	Start	Finish
1	21%	Calpine Pilot Proposal	936 days	Wed 10/14/20	Wed 5/15/24
2	100%	DOE Project Award Start	0 days	Wed 10/14/20	Wed 10/14/20
3	0%	Final Report Due	0 days	Fri 5/10/24	Fri 5/10/24
4	34%	Task 1 - Project Management and Planning	933 days	Wed 10/14/20	Fri 5/10/24
5	22%	1.1 - Revision and Maintenance of the PMP	849 days	Fri 10/30/20	Wed 1/31/24
10	100%	1.2 - Technology Maturation Plan	90 days	Wed 10/14/20	Tue 2/16/21
15	52%	1.3 - EH&S Risk Assessment	933 days	Wed 10/14/20	Fri 5/10/24
16	100%	Initial EH&S	70 days	Wed 10/14/20	Tue 1/19/21
21	0%	Final EH&S	623 days	Wed 12/22/21	Fri 5/10/24
27	50%	1.4 - Techno-Economic Assessment	933 days	Wed 10/14/20	Fri 5/10/24
28	100%	Preliminary TEA	50 days	Wed 10/14/20	Tue 12/22/20
33	0%	Final TEA	50 days	Mon 3/4/24	Fri 5/10/24
38	100%	1.5 - Host Site Agreement	15 days	Wed 10/14/20	Tue 11/3/20
42	22%	1.6 - Reporting, Briefings and Technical Presentations	923 days	Wed 10/14/20	Fri 4/26/24
65	98%	Budget Period 1 - Design	230 days	Wed 10/14/20	Tue 8/31/21
66	98%	Task 2 - Design of 1MWe (10 tpd) NGCC Pilot	230 days	Wed 10/14/20	Tue 8/31/21
67	100%	2.1 - Carbon Capture System Basic Engineering	171 days	Wed 10/14/20	Wed 6/9/21
68	100%	Design Basis	168.5 days	Wed 10/14/20	Mon 6/7/21
80	100%	Process Design Package	151 days	Fri 11/6/20	Fri 6/4/21
122	100%	Cost Estimate for Detailed Engineering & Construct	15 days	Thu 5/20/21	Wed 6/9/21
124	100%	2.2 - Balance of Plant Design	174 days	Mon 11/2/20	Thu 7/1/21
125	100%	Design Criteria	98 days	Mon 11/2/20	Wed 3/17/21
130	100%	Conceptual Layout BOP Equipment	16 days	Wed 2/3/21	Wed 2/24/21
133	100%	General Arrangement	27 days	Mon 4/5/21	Tue 5/11/21
138	100%	3D Model Development	20 days	Mon 3/29/21	Fri 4/23/21
141	100%	Laser Scanning	14 days	Wed 3/31/21	Mon 4/19/21
144	100%	CO2 Equipment Foundation	15 days	Wed 4/21/21	Tue 5/11/21
148	100%	BOP Equipment Foundation	15 days	Mon 4/19/21	Fri 5/7/21
152	100%	BOP Utility Structural Steel	15 days	Mon 5/3/21	Fri 5/21/21
156	100%	BOP Civil/Structural QTY Take-Off	5 days	Mon 5/17/21	Fri 5/21/21
158	100%	BOP Mech Equipment Data Sheets	25 days	Mon 4/26/21	Fri 5/28/21
163	100%	BOP Equipment List	38 days	Tue 2/23/21	Thu 4/15/21
168	100%	BOP Pipe, Valve, Speciality, Terminal Point Lists	20 days	Thu 4/1/21	Wed 4/28/21
173	100%	BOP P&IDs	25 days	Thu 3/18/21	Wed 4/21/21
178	100%	BOP Mech. QTY Take Off	5 days	Thu 4/29/21	Wed 5/5/21
180	100%	Electrical Load List	35 days	Fri 3/26/21	Thu 5/13/21
185	100%	Single Line	30 days	Fri 4/23/21	Thu 6/3/21
190	100%	Electrical Design (Cable Tray , Grounding, lighting E	15 days	Mon 4/26/21	Fri 5/14/21
194	100%	Instrument & I/O List	15 days	Thu 4/22/21	Wed 5/12/21
199	100%	BOP Design Package	0 days	Thu 6/3/21	Thu 6/3/21
200	100%	Construction Subcontractor Selection	0 days	Thu 6/3/21	Thu 6/3/21
201	100%	BOP Elec. QTY Take-Off	5 days	Fri 5/14/21	Thu 5/20/21
203	100%	BOP Cost Estimate	29 days	Mon 5/24/21	Thu 7/1/21
208	99%	2.3 - Permitting	170 days	Wed 10/28/20	Tue 6/22/21
209	99%	Bay Area Air Quality Management District Permit	120 days	Wed 10/28/20	Tue 4/13/21
215	99%	Californial Energy Commission Permit	130 days	Wed 12/23/20	Tue 6/22/21
220	100%	Go/No-go Decision for BP2 (Calpine Review)	10 days	Fri 7/2/21	Thu 7/15/21
221	33%	DOE approval	33 days	Fri 7/16/21	Tue 8/31/21

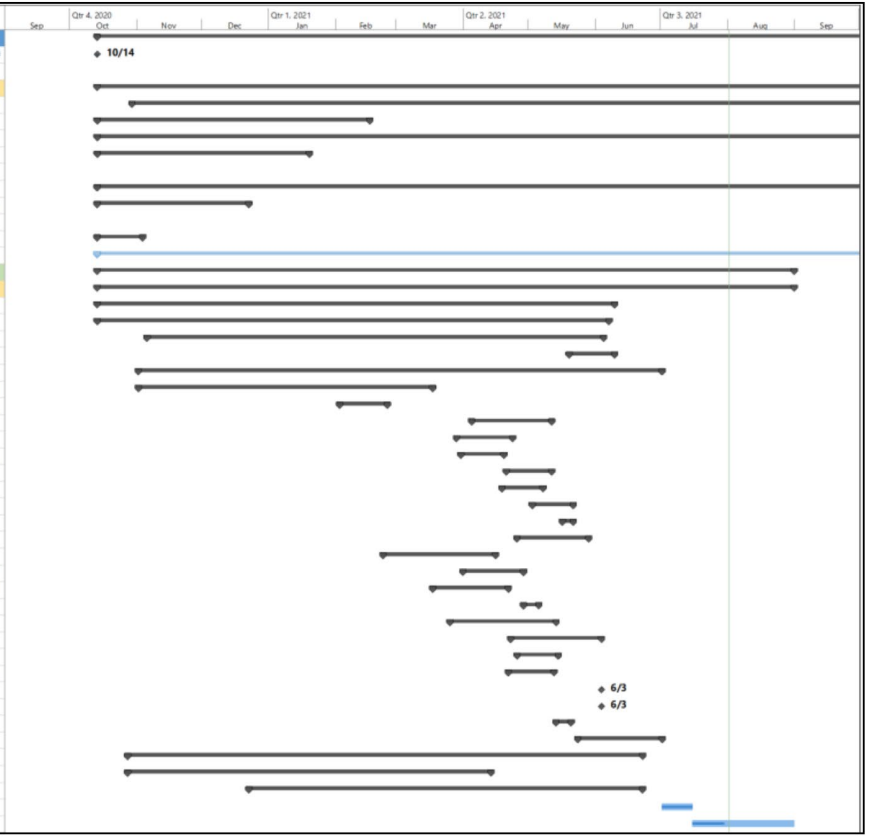


Figure 1: Project Schedule (Revised July 2021)